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THE MARINE ALGAE OF OREGON [1]

PART I. CHLOROPHYTA AND PHAEOPHYTA

MAXWELL S. DOTY

INTRODUCTION

This study, a report on the marine algae known to occur along the Oregon coast, is based for the most part on the author's collections. Chief among the other sources of material have been the herbarium of the University of California and the Dudley Herbarium of Stanford University. The collections of Orla Ray O'Neal, the author's companion during most of the field studies, have provided a great number of novelties and records that otherwise would have been unobtainable. Very important records have been obtained from the herbarium of the Oregon Institute of Marine Biology, and from the collections of Professors Wayne Wells, at the Southern Oregon College of Education, and F. P. Sipe of the University of Oregon. Sources of material are cited by the herbarium number or other identifying data preceded immediately by the name of the collector (*MD* in the case of the author's collections) or the herbarium in which the material is deposited.

All types of new species and varieties, representative specimens of all the species collected, and specimens of significance in geographical distribution, are deposited in the Dudley Herbarium of Stanford University. As far as the material permitted, specimens have been deposited in the Farlow Herbarium of Harvard University, the herbarium of W. R. Taylor at the University of Michigan, and in the herbaria of the Chicago Museum of Natural History and the University of California. Because of the large number of specimens examined and because many are very well known, only specimens of special interest or those distributed are cited specifically in the text.

Unless otherwise stated the ranges cited and the records for the occurrence are based upon the author's investigations. In most cases bibliographic references are limited to the most pertinent publications and to those in which additional bibliography may be found.

[1] The systematic portion of studies of this region carried out and presented to the School of Biological Sciences of Stanford University as a doctoral dissertation. The second part of this paper, with the bibliography, is to appear in the next number of this journal.

VERTICAL DISTRIBUTION

In Oregon as elsewhere along the Pacific Coast of North America there is a pronounced difference between the levels to which two successive low tides fall. The same is true of the maximum levels of two successive high tides. This results in the establishment of at least six critical breaks or levels in the intertidal zone. For the sake of brevity the levels are cited by the abbreviations [2] LLLW, MLLW, LHLW, HHLW, LLHW, and LHHW. The lowermost level (LLLW) is the lowest level to which the tides recede. The next level above this (MLLW) is the mean of the lower of the two low waters of each day. Next is the highest level (LHLW) uncovered no more than once each day. Above this the next level (HHLW) is near mean sea level. The next (LLHW) is the lowest level covered (and uncovered) at least twice each day. The uppermost level (LHHW) is the highest level covered every day.

The elevation of these critical levels in respect to mean lower low water at any given place along the coast is in turn dependent upon the mean range of tides there. For example, at Brookings the mean tidal range is 5.1 feet, at Wederburn at the mouth of the Rogue River the mean tidal range is 4 feet, and at Youngs Bay near Astoria the mean tidal range is 6.7 feet. The zones delimited by these critical levels are correspondingly narrow or broad as the mean tidal range is small or large. Because of the above facts the vertical distribution of the species is noted in reference to these levels rather than in feet above or below some datum point.

The lowest level (LLLW) to which the lowest tides recede is the upper limit of the vertical distribution of *Laminaria Andersonii*. Widely distributed algae between the lowest level to which the lowest tides fall and the mean of the lower of the two low waters of each day are *Pikea, Rhodymenia, Polyneura, Zanardinula,* and *Laminaria Sinclairii*. Characteristic algae of the zone between the mean of the lower of the two low waters (MLLW) and the highest level uncovered but once each day (LHLW) are *Hedophyllum sessile, Egregia Menziesii, Gigartina canaliculata,* and *Rhodomela larix*. Characteristic algae of the zone between the LHLW level and the highest level always uncovered twice each day (HHLW) are *Iridophycus flaccidum, Gigartina Agardhii,* and *Cladophora trichotoma*. The zone between HHLW and the highest level covered at least twice each day (LLHW) is indicated by *Endocladia muricata, Gigartina papillata,* and *Pelvetiopsis limitata*. A less consistent zone often occupied by *Gloiopeltis furcata* and *Hildenbrandia* extends, then, up to the highest level covered at least once each day (LHHW). Above the LHHW level the dominant algae are *Prasiola meridionalis, Por-*

[2] These abbreviations are taken from the following characteristics of the tides: LLLW, lowest lower low water level; MLLW, mean lower low water level; LHLW, lowest higher low water level; HHLW, highest higher low water level; LLHW, lowest lower high water level; and LHHW, lowest higher high water level. For further elaboration see Doty, Ecology **27:** 315–328. 1946.

phyra schizophylla, and *Rhodochorton purpureum*, but these are very restricted in distribution.

STATIONS AT WHICH COLLECTIONS WERE MADE

As originally planned it was hoped that extensive collections could be made from all the stations selected approximately 30 minutes of latitude (25 to 30 miles) apart along the entire coast of Oregon from St. George's Reef in northern California to the Columbia River Bar. Wartime rationing of gasoline during the past few years has necessitated curtailment of this plan and intensive collecting has been restricted to the coast between California and Coos Bay.

Names of collection stations to be found on U. S. Coast and Geodetic Survey hydrographic charts 5702, 5802, 5902 and 5984 are designated as *official*. *Unofficial* names do not appear on Coast and Geodetic Survey charts but are on maps published by the Oregon State Highway Department. *Local* names are those employed by the local residents or collectors. Stations with unofficial and local names are to be found on the Coast and Geodetic Survey charts either from the latitude (north latitude in all cases) given or by cross reference to official names. Since all stations along the coast are between 123° 36′ and 124° 34′ west longitude, the longitude for individual stations is omitted.

AGATE BEACH. Unofficial name for the rocky beach accessible along the southern shore of Yaquina Head.

BOILER BAY. (44° 50′) Unofficial name for an exposed field of huge boulders that is exposed to the northwest and protected from the southwest by high reefs.

BROOKINGS. (Between 42° 1′ and 40° 2′) Official. Next to Cape Arago, this area is second in importance in the way of supplying the data included herein.

BROOKINGS COVE. Local name for Macklyn Cove.

BROOKINGS POINT. Local name for Chetco Point.

CANNON BEACH. Official name for the beach north of Haystack Rock.

CAPE ARAGO. (Between 43° 16′ and 43° 21′) Official name for the series of headlands and coves extending 10 miles southward from the entrance at Coos Bay. The search for algae has been more intense here than at any other station.

CAPE BLANCO. Official name for the most westerly point of land in the United States at 42° 50′. An extremely exposed tongue with both a long northern and southern rocky shore.

CAPE LOOKOUT. (45° 20′ 30″) Official.

CAPE MEARS. (45° 29′) Official.

CAPE PERPETUA. (44° 17′) Official.

CASCADE HEAD. (45° 17′) Official.

CHARLESTON. Unofficial. A village on the western shore of South Slough near the site of the Oregon Institute of Marine Biology.

CHETCO COVE. Official. A part of the Brookings area.

CHETCO POINT. Official. A part of the Brookings area.

CLATSOP SPIT. (46° 14′) Official. As used here it includes both the area of the spit proper and the south jetty at the mouth of the Columbia River.

COOS BAY. (Between 43° 21′ and 43° 28′) Official name for the bay immediately north of Cape Arago.

COOS HEAD. Official. A part of the Coos Bay area.

EMPIRE. Official. A part of the Coos Bay area.

FIN ROCK. Unofficial name for a large and conspicuous fin-shaped rock off the southern shore of Cape Blanco.

FOSSIL POINT. Official. A part of the Coos Bay area.

HARRIS STATE PARK. Unofficial name used here to designate not only the park area itself, but also the rocky coastline south to the northern tip of Macklyn Cove.

HAYSTACK ROCK. (45° 53′) Official. Including the rocky boulder field about this rock and adjacent rocks.

HECETA HEAD. (44° 8′) Official. The rocky beach to the south and the rocks near the mouth of Cape Creek.

LIGHTHOUSE BEACH. Local name for the beach just north of the Cape Arago lighthouse on Cape Arago.

LIGHTHOUSE REEF. Local name for the reef upon which is situated the Cape Arago lighthouse.

MARSHFIELD. Official. Recently renamed "Coos Bay".

MIDDLE BAY. Unofficial name for the cove indenting the most south-westerly tip of Cape Arago.

MUSSEL REEF. Local name for a series of reefs on Cape Arago just north of Lighthouse Reef and Lighthouse Beach.

NEHALEM BAY. (45° 39′) Local name for the south jetty at the mouth of the Nehalem River.

NORTH BAY. Unofficial name for the cove and boulder field north and northwest of the most southwesterly tip of Cape Arago.

NORTH BEND. Official. A city on Coos Bay.

OCEANSIDE. (45° 28′) Here used to indicate the collecting area between Three Arch Rocks and Cape Mears.

OTTER POINT. (42° 28′) Official name for a part of the base of the Rogue River Reef. All collections are from the south side of this point.

OTTER ROCK. (44° 45′) Here used to refer both to the beach and caves near the town of this name — all inshore and somewhat north of the rock officially bearing this name.

ROGUE RIVER REEF. (Between 42° 37′ and 42° 28′) Official. The only collecting on this reef was done along the shore south from Otter Point.

SEAL ROCKS. (44° 30′) Official.

SHORE ACRES. Local name for the region immediately south of Sunset Bay.

SHORT SAND BEACH. (45° 45′ 30″) Unofficial name for the largest of the coves between Neahkahnie Mountain and Cape Falcon (both official names).

SIUSLAW BAY. (43° 45′) Unofficial.

SIUSLAW JETTY. Local name for the north jetty at the mouth of the Siuslaw River.

SOUTH BAY. Unofficial name for South Cove.

SOUTH COVE. Official. On the southern protected side of the most southwesterly tip of Cape Arago.

SOUTH JETTY. Local name for the south jetty at the entrance to Coos Bay.

SOUTH SLOUGH. Official. An arm of Coos Bay.

SQUAW CREEK. (44° 12′ 30″) All collections are from the rocks at the mouth of this stream.

SQUAW ISLAND. Unofficial name for the tree-covered island in the mouth of Sunset Bay.

SQUAW ISLAND REEF. Local name for the reef connecting Squaw Island to the mainland and extending on beyond the island into the mouth of Sunset Bay.

SUNSET BAY. Unofficial name for the bay just south of Lighthouse Reef.

SUNSET BEACH. Local name for Sunset Bay.

TEGULA BAY. Local name for the first small bay south of Sunset Bay.

TILLAMOOK HEAD. (45° 56′ 30″) Official.

WINCHESTER BAY. (43° 41′).

YACHATS. (44° 19′) Official. Here used to designate the area just north of the river by the same name.

YAQUINA BAY. (44° 37′) Official.

YAQUINA HEAD. (44° 40′ 30″) Official. The collecting grounds are principally at Agate Beach on the south side.

ACKNOWLEDGMENTS

The author's indebtedness to the many persons and institutions mentioned throughout the text is obvious, but the kindnesses of the following must be mentioned in particular. Dr. W. R. Taylor obligingly lent the author his collections of *Enteromorpha linza*, and provided notes on other subjects. Through numerous cheerful courtesies, Dr. George F. Papenfuss has made the author feel at home in the University of California herbarium and in the library of the late W. R. Setchell. Dr. George J. Hollenberg, especially early in the course of this study, gave constant assistance and a large number of careful determinations and critical comments on specimens sent him, some of which are described herein either as new species or species heretofore poorly known. Finally, I am greatly indebted to Dr. G. M. Smith, under whose direction the original dissertation was undertaken and completed.

ANNOTATED SYSTEMATIC LIST

DIVISION CHLOROPHYTA

TETRASPORALES

CHLORANGIACEAE

COLLINSIELLA Setchell & Gardner, 1903

Collinsiella tuberculata Setchell & Gardner, 1903:204. *pl. 17, figs. 1–7*; — Setchell & Gardner, 1920b:144. *pl. 10, figs. 4–10*; — Smith, 1944:31.

The range of this species is given by Setchell & Gardner as Vancouver Island and Central California. Several tetrasporine green algae have been found in typical habitats, but none could be *clearly* identified as this alga.

ULOTRICHALES

ULOTRICHACEAE

ULOTHRIX Kützing, 1833

Ulothrix flacca (Dillwyn) Thuret *in* LeJolis, 1863:56; — Setchell & Gardner, 1920b:284.

A very few isolated strands of this species have been identified among collections of various other algae from mid- and high tide levels at different stations on Cape Arago.

Ulothrix implexa Kützing, 1849:349; Setchell & Gardner, 1920b:283; — Smith, 1944:34. *pl. 1, figs. 4–5*.

One collection (*MD 5988*, Middle Bay) has been made from rocks around and protruding from tidepools at plus 10 foot tidelevels. This was mixed with a juvenile thallus of *Enteromorpha clathrata*. About one third of the cell wall is left uncovered by the chloroplast and the cells are mostly 2–2.5 times as long as broad.

Ulothrix zonata (Web. & Mohr) Kützing, 1833:519; — Collins, 1909b:184.

Filaments 45 μ in diameter with the cells 0.5–1.5 times as long as broad; basal cells regularly tapered or rectangular and usually 2 or 2.5 times as long as broad, as are the next few cells above.

This species has been found in the mouths of creeks reached by the highest spring tides. Either it develops between such high tide periods or is able to stand the few hours of exposure to salt water during these high tides. There are two collections (*MD 6210*, one quarter mile south of Harris State Park, July; and *MD 6299*, Squaw Creek, September) that have been collected from boulders in such localities. This alga is common in Oregon maritime streams.

Ulothrix pseudoflacca Wille, 1901:22; — Setchell & Gardner, 1920b:285.

This species is reported from Cape Arago by Sanborn and Doty (*ined.*). The writer has not been able to examine these specimens during the course of this study.

HORMIDIUM Kützing, 1843

Hormidium rivulare Kützing, 1845:192; — Hazen, 1902:166. *pl. 22, figs. 10–13.*

PLATE 5, FIGS. 2–4; PLATE 6, FIGS. 1–9

Older filaments becoming irregular in size and in diameter up to 12 μ, most of the filaments about 9 μ with the smallest 7–8 μ in diameter and then very regular in size; cells up to as long as broad except where rhizoidal branches are forming; no starch found in younger filaments but in the older and larger filaments pyrenoids with concavo-convex pyrenoid-starch grains around them may be found; there is very little stroma starch, if any, and the pyrenoids are for the most part at the ends of the chloroplasts; the chloroplasts nearly filling the cells; rhizoidal branches at intervals of two to three hundred cells at the most.

Forming a green felty layer on the woodwork of a wharf at Winchester Bay (*MD 4716*, early July). *H. rivulare* has previously been considered a strictly fresh-water species. While most of the water that bathes the site is fresh water, this particular site is often washed with sea water during the landing and weighing of the fishermen's catches, and in the lower reaches probably by the highest of the high tides.

In rhizoidal branches the chlorophyllous material was often, at least in the largest branches, diffused through the whole cell as though the cell were in a poor state of health and disintegrating. The mass of mucilaginous substance about the tips of the larger rhizoidal filaments often contained cells or fragments of cells entirely separate from one another but often distinctly oriented in the same manner as cells of a rhizoidal filament. It is uncertain whether or not these *Stichococcus*-like cells were budded off from the rhizoidal branches, whether they are merely passively caught as foreign bodies in the gelatinizing matrix, or whether they are the products of rhizoidal branchlets undergoing disintegration.

CHAETOPHORACEAE

ENTOCLADIA Reinke, 1879

Gardner in his notes under *2743* records the genus *Endoderma* from *Cladophora flexuosa* collected near North Bend. It is presumed that this was some species of the genus *Entocladia.* The specimen was not seen.

PSEUDULVELLA Wille, 1909

Pseudulvella consociata Setchell & Gardner, 1920a:296. *pl. 24, figs. 4–6*; — Setchell & Gardner, 1920b:297. *pl. 19, figs. 4–6.*

There are two collections from South Bay (*MD 4150* and *4089*, both collected in January), the former on the shells of living *Tegula funebralis* and the latter on a limpet (*Acmaea* sp.) in an exposed situation.

ENDOPHYTON Gardner, 1909

Endophyton ramosum Gardner, 1909:372. *pl. 14, figs. 3–4*; — Smith, 1944:36. *pl. 1, fig. 6.*

Found once at Brookings in the fronds of *Dilsea californica* (*MD 6123*), and in Gardner's notes recorded from *Callophyllis* at Cape Arago.

PSEUDODICTYON Gardner, 1909

Pseudodictyon geniculatum Gardner, 1909:374. *pl. 14, figs. 5–6*; — Setchell & Gardner, 1920b:293. *pl. 11, figs. 5–6*; — Smith, 1944:37.

Under number *2783* in his notebook Gardner records this species on the outer ends of *Laminaria Sinclairii* fronds from Sunset Bay.

The author has several times found filamentous green algae endophytic in Laminariales that seemed to be this alga, but which could never be determined with certainty.

TRENTEPOHLIACEAE

TRENTEPOHLIA Martius, 1817

In many places this well-known fresh water genus extends from strictly aerial to supra- or quasi-marine habitats. Setchell & Gardner (1920b:306) identify the *Trentepohlia* in quasi-marine habitats in southern California as *T. odorata* var. *umbrina* (Kütz) Hariot. The Oregon material does not seem to be *T. odorata*, nor any of its varieties.

GOMONTIA Bornet & Flahault, 1888

Gomontia polyrhiza (Lagerheim) Bornet & Flahault, 1888:163; — Smith, 1944:41. *pl. 1, figs. 8–11*; *pl. 2, figs. 1–7.*

The Oregon specimens show the same variation as described by Smith. One collection from Coos Bay (*MD 4894*) was in the skeletons of sea urchins (*Strongylocentrotus purpuratus*). Other collections from Coos Bay have been made from the shells of *Protothaca staminea*, *Clinocardium nuttallii*, *Saxidomus gigantea*, *Macoma irus*, and *Macoma kelseyi*, all bivalves.

On the west coast, previously known only from Neah Bay, Washington,

and the Monterey Peninsula, but in our range common in the Coos Bay and Cape Arago regions.

ULVALES

ULVACEAE

ULVA Linnaeus, 1753

As delimited in this study this genus includes those Ulvaceae that are never at any time tubular, and whose fruiting areas are restricted to the blade margins. The original margin of the frond is composed of a few cells (about 3); these marginal cells are no taller than the submarginal cells and the frond is no thicker at the margin than elsewhere. The fronds are broad in relation to height, and the base if cylindrical is shorter than its diameter.

The Oregon species of this genus can be segregated into four groups: (1) narrow branched species decidedly thicker in the center of the thallus than at the dentate margins; (2) broad species with the cells when seen in cross section in the center of the thallus distinctly taller than square, and at least in one (*U. lobata*) the gametes are anisogamous; (3) broad species with the cells in the center of the thallus about square in cross section, and the margin about as thick as the center of the thallus; and (4) species with cells tall in cross section and about the same height throughout, and with juvenile narrowly wedge-shaped thalli that become increasingly broad with age.

KEY TO THE SPECIES KNOWN TO OCCUR IN OREGON

1. Blades narrow or linear, with dentate margins near base..... **U. taeniata**
1. Blades broadly elliptical or ovate or cuneate, with smooth margins..... 2
2. Blades ovate or broader, often decidedly thinner at margin; if not, cells near the margins square in cross section..... 3
2. Blades elliptical or cuneate, margins about as thick as the central portion; cells always taller than broad in cross section..... 5
3. Cells at the center of thallus approximately square in cross section; thalli large and expanded, light green in color..... **U. expansa**
3. Cells at the center of thallus taller than broad in cross section; thalli not in a broadly expanded sheet, dark green in color..... 4
4. Margins of blade about half as thick as center of blade; perforations of blade, if present, irregular and not progressively larger toward the margins **U. lobata**
4. Margins of blade over half as thick as center of blade; perforations always present, progressively larger toward margin of blade..... **U. fenestrata**
5. Under 3 cm. tall; in dense stands near high tide level..... **U. californica**
5. Over 10 cm. tall; growing in tufts between LHLW and MLLW.... **U. stenophylla**

Ulva taeniata (Setchell) Setchell & Gardner, 1920a:286. *pl. 28*; — Setchell & Gardner, 1920b:273. *pl. 23*; — Smith, 1944:48. *pl. 3, figs. 1–3.*

PLATE 2, FIGS. 11–12; PLATE 4, FIGS. 3–4

Common throughout the range between MLLW and LHLW.

In surface view the cells along the margin are small and close fitting, 7–8 x 8–10 μ, tending to be quadrangular, and often in rows; cells along

the axis of the frond, while still in rows in surface view, tend to be somewhat distant from each other and rounded-polygonal in outline though often elongated parallel to the axis of the blade and up to 14 x 28–32 μ. The axial portion of the frond is up to 95 μ thick just above the rhizoidal region, midway between base and apex usually about 70 μ thick, but near the apex it thins down to 30 or 35 μ. The blades become thinner from the axis toward the margin, where they are from 17–30 μ in thickness. In the rhizoid producing basal region the margins are often somewhat enteromorphoid, but the cells are not in proportion taller than those from the center of the frond.

The blade of the type of *Ulva dactylifera* in the University of California herbarium (*Gardner 1938*) has dentations on the margins and these can also be seen in Setchell & Gardner's illustration of this specimen (1920a, *pl. 26, fig. 1*). It does not seem to be greatly different in any character from some young forms of *U. taeniata* from Oregon.

Ulva taeniata is the only Oregon species with dentate margins and so the only Oregon member of the first section, the section to which *U. fasciata* belongs. In the very youngest specimens seen (*O'Neal 435*, on *Odonthalia* at Seal Rocks, July) the entire margin, including the apical regions, is dentate. From this material it seemed evident that branching of adult thalli results from further proliferation or enlargement of the denticulations, rather than by an increase in size or division of the primary bladelet. As a result the upper portions of older fronds are smooth-margined, with denticulations restricted to the margins near the base.

Ulva fenestrata Postels & Ruprecht, 1840:21. *pl. 37*; — Setchell & Gardner, 1920b:267.

PLATE 2, FIG. 3

Along the coast of Oregon north of Rogue River Reef, usually on small boulders in the bottoms of low-lying, gravel-bottomed tidepools.

At the center of the thallus, as seen in cross section, the cells are from 1.5–3 times as tall as broad. Larger thalli are about 45 μ in thickness, smaller thalli about 70 μ. The largest specimens (*MD 2690*, North Bay; *MD 6222*, Rogue River Reef) are some 40 cm. tall; some small juvenile thalli are about 6 cm. tall (*Wayne Wells 36* and *42*, Coos Bay; *MD 6222*). Other Oregon material, including some of the above Wells collections, seem, by their irregularly arranged perforations and other characteristics, to be forms of either *U. lobata* or *U. expansa*.

Material collected on the Oregon Coast is similar to specimens identified as this species by Setchell and Gardner. Though somewhat less perforate, the Oregon material is similar to the illustrations by Postels and Ruprecht in that the smallest holes are near the center of the blade and these holes become progressively larger toward the margins. At the margins the perforations break open, leaving narrow free blade segments. Specimens of *U. expansa* collected at Monterey (*MD 5666* and others in the Dudley Herbarium) have holes in the thallus, but these are not so progressively arranged according to size, and the blades are never divided into narrow

segments at the margin. It should be noted that the Alaskan specimens in the University of California herbarium are much more fenestrate than those from along the coast of Oregon. *Ulva reticulata* (*Phycoseris reticulata*) as illustrated by Kützing (1856, *pl. 29*) and by material seen in the Dudley Herbarium from Hawaii, is different in that the fenestration divides the thallus into a network of almost linear meshwork and the whole thallus is much smaller.

Ulva lobata (Kützing) Setchell & Gardner, 1920a:284; — Setchell & Gardner, 1920b: 268; — Smith, 1944:46. *pl. 4, figs. 4–5.*

Common from the MLLW-LHLW beaches south of Chetco Cove to Coos Bay and further north at least to Agate Beach. One collection (*H. C. Luce 4*) was dredged in an otter trawl by Clarence Hubbard at a depth of 35 fathoms, 8 miles north off the Coos Bay bar. Since this was mostly on mud and sand bottoms the specimen was very possibly a free floating one.

The largest Oregon specimen is some 150 μ thick near the base, 95 — 100 μ in the center of the thallus above, and 70 μ along the margin; other specimens are from 70 — 95 μ thick in the center, as thin as 25 μ on the upper margins, and 45 μ in thickness along the lateral margins.

Ulva expansa (Setchell) Setchell & Gardner, 1920a:284; Setchell & Gardner, 1920b: 268; Smith, 1944:46.

Only in South Slough were specimens seen which seemed to be this species. These specimens were attached to small rocks and stones in the mud on tide flats. The thalli were up to 20 — 30 cm. broad and perhaps a meter or more long. The South Slough material is similar to a specimen in the University of California herbarium (*Gardner 2086*) from Dillon's Beach, San Mateo County, California. *Ulva lactuca* specimens reported in Sanborn and Doty (*ined.*) are for the most part this species and fragments of very large specimens of *U. lobata.*

Ulva stenophylla Setchell & Gardner, 1920a:282. *pl. 26, fig. 2*; *pl. 29*; — Setchell & Gardner, 1920b:271. *pl. 21, fig. 2*; *pl. 24*; — Smith, 1944:47.

PLATE 2, FIGS. 1–2

In Oregon known only from Chetco Cove (*MD 6126*) on LHLW rocks. The Pacific Coast range is south from here to Big Sur, Monterey County, California (latter station based on *MD 4039*, Dani ranch).

This is the only broadly lanceolate (or elliptical) thick, dark green *Ulva*, of large size, known along the coast of Oregon. The smallest (2 — 5 cm. tall) and narrowest thalli are narrowly cuneate and *Enteromorpha*-like. Others are broad and in form not unlike narrow forms of *U. lobata.* From this latter species they differ in being about as thick at the margin as near the center. *Ulva lobata* has a small broad blade increasing in breadth all along the margin, whereas *U. stenophylla* is at first lanceolate and then broadens. The distribution of fruiting areas is unknown. The smallest thalli found intermingled with large thalli have tubular bases or margins similar to those of *Enteromorpha.* Perhaps these small thalli are not the

same species since the large fronds have nothing enteromorphoid about them.

Ulva californica Wille, 1899, *in* Collins, Holden & Setchell, Phyc. Bor.-Amer. fasc. 13:611; — Setchell & Gardner, 1920b:264.

PLATE 2, FIGS. 6–10

Forming patches of low thalli near high tide level; locally abundant from South Bay south throughout the range. The following discussion is based upon these four collections made between South Bay and Moss Beach, San Mateo County, California, as follows: *MD 2277*, South Bay; *MD 6187*, between plus 3.0 and plus 8.0 feet at Otter Point; *MD 6296*, just below and with the lowest *U. vexata* along the north shore of Chetco Cove, July; and *MD 6289*, Moss Beach, San Mateo County, California.

Though thalli of Oregon specimens are for the most part of greater stature than Setchell and Gardner's specimens in the University of California herbarium, other characters indicate that it is this species. These characters are: (1) narrowly cuneate juvenile stages; (2) a short cylindrical stipe that becomes shorter as the holdfast broadens and finally includes a flat marginal section of the blade base; (3) a margin which is about as thick as the center of the thallus; (4) thalli usually less than 2.0 cm. tall, but which sometimes are up to 3 cm. tall; and (5) the habit of growing in small patches on tops and sides of rocks near mean sea level. However, where conditions are favorable, it appears higher, in more or less dwarfed form. While the cells near the rhizoidal portion of mature thalli are in indistinct rows which tend to become irregular, those in the blade are more squarish and in places in very distinct rows. As seen in surface view the cells of the blade are 10 — 12 μ in diameter, though some of the more rectangular ones are 6 — 8 x 10 — 14 μ. The base of the blade is solid and with the cells at the margin arranged in the typical ulvoid manner. Here the center and margin are 55 — 60 μ in thickness and there is no trace of any separation between the two cell layers. The upper portion of the blade is thinner (47 — 50 μ) than the base, but with the same sort of margin. The gelatinous material between the two layers of cells, so often conspicuous in other species, is only very slightly if at all developed in the upper portions of the blade of *U. californica*. Isotype material examined is thinner in cross section, 60 μ in thickness near the base but only 35 — 45 μ in the upper portion. In the broad or more mature thalli the cells are, in cross section, from as broad as tall to one-fourth as broad as tall.

MONOSTROMA Thuret, 1854

Monostroma zostericola Tilden, 1900, *in* North Amer. Algae no. 308; — Setchell & Gardner, 1920b:238. *pl. 14, figs. 12–13*; — Smith, 1944:43.

PLATE 2, FIGS. 4–5

On *Phyllospadix* at all stations from Agate Beach to Brookings.

Most Oregon collections are like Yamada's Japanese specimens from the

Kurile Islands in the University of California herbarium and specimens from Moss Beach, San Mateo County, California (*Gardner 6259* and *4910*; and *MD 6059*). The usual height of Oregon specimens is 1 cm. or less but thalli of one collection (*O'Neal 227*, North Bay) are up to 4.5 cm. tall. The blades as seen in cross section are up to nearly 20 μ in thickness with the cells close together and the height usually more than twice the breadth. In *M. oxyspermum*, the other species along the Oregon coast, the cells are usually as broad or broader than tall and often remote from each other.

Monostroma oxyspermum (Kützing) comb. nov.

Ulva oxysperma Kützing, 1843:296; — Kützing, 1849:474.
Ulva latissima Kützing, 1843:296; — Kützing, 1845:244; — Kützing, 1856:7. *pl. 14.*
Monostroma latissimum (Kützing) Wittrock, 1866:33. *pl. 1, fig. 4*; — Setchell & Gardner, 1920b:241.
Ulva oxycocca Kützing, 1845:244; — Kützing, 1849:474.
Monostroma oxycoccum (Kützing) Thuret, 1854b:29; — Wittrock, 1866:32; — Hamel, 1931:54.
Monostroma laceratum Thuret, 1854b:32.
Monostroma orbiculatum Thuret, 1854c:388; — Setchell & Gardner, 1920b:242.
Ulva quaternaria Kützing, 1856:6. *pl. 13, fig. 2.*
Monostroma Wittrockii Bornet (*fide* Hamel, 1931).

PLATE 2, FIGS. 13–15

Common in Coos Bay and other bays in the range. In brackish water and in a fresh water lake in the sand of Chetco Cove.

Monostroma orbiculatum, *M. latissimum* and *M. quaternarium* are considered to be distinct species by Setchell & Gardner (1920b), but they had doubts as to the separability of the three. Study of sections of Pacific Coast specimens of these species as determined by Setchell & Gardner leads to the conclusion that they are but forms of one species. Their *M. orbiculatum*, the largest (*i.e.*, up to 30 x 40 cm.) and the thickest (up to at least 40 μ thick), is very light in color and some specimens are nearly colorless as though in poor health or senescent. The only West Coast specimens are from San Francisco Bay and an annotation by Collins on one (*Setchell 1255*) says, "I do not feel certain, but still think on the whole, correct, F. S. C." *Monostroma latissimum* as known on the West Coast is intermediate in nature between *M. orbiculatum* and *M. quaternarium*, and presumably differs from the latter in the arrangement and shape of the cells. In *Enteromorpha* and *Ulva* apparently this surface appearance of the cells is somewhat correlated with age and it seems that the same phenomenon is at play here in *Monostroma*, as shown by the collections investigated.

Hamel (1931:51) unites the three in a single species. He selected Kützing's name *oxycocca*. Kützing cites (1845:244) his earlier validly published name, *Ulva oxysperma*, as a synonym of his *Ulva oxycocca*, presumably because he considered *oxycocca* a more appropriate name. This is contrary to the International Rules; the earliest legitimate epithet for the entity must be chosen, and this is *Ulva oxysperma* Kützing (1843:296)

insofar as this author is aware. The synonymy cited above for European species is taken for the most part from Hamel's and from Wittrock's papers.

ENTEROMORPHA Link, 1820

The most reliable criterion for distinguishing between this genus and *Ulva* is the character of the blade margin. In *Enteromorpha* the margins are composed of more than three cells and these cells are as tall as, or taller than, those nearer the center of the thallus. Usually the margins are hollow or with the gelatinous material between the cell layers distinctly thickened. In *Ulva* the margins are composed of about three cells, the proportions of which are about the same as those of the submarginal cells. The margins of the blades of *Ulva* are neither hollow nor with a thickening of the gelatinous material between the two cell layers.

KEY TO THE SPECIES OF *ENTEROMORPHA* KNOWN FROM OREGON

1. Thalli broadened above with the two cell layers adhering to each other; unbranched 2
1. Thalli narrowed above or tubular throughout; usually branched 5
   2. Many of the cells in cross section as tall as, or taller than, broad; upper portion of blades over 20 μ thick 3
   2. All cells in cross section broader than tall; upper portion of blades under 20 μ thick ..... **E. linza**
3. Usually infected with fungi and the margins not hollow, if uninfected only the margin tubular; the stipe compressed, with the cell layers adhering throughout ..... **E. vexata**
3. Never infected with fungi; margins of blade and base of stipe tubular 4
   4. Blade light green; stipe short (up to 2 cm. long), linear, abruptly broadened above and compressed; blade usually under 50 μ thick, the cells often broader than tall in cross section ..... **E. angusta**
   4. Blade dark green; the stipe long, narrowly cuneate, and gradually broadening above; blade usually over 50 μ thick, with the cells taller than broad in cross section ..... **E. linza**
5. Cells in surface view regularly under 10 μ in any dimension ..... **E. minima**
5. Cells in surface view regularly over 10 μ in one dimension 6
   6. Cells, except in basal portion, not arranged in rows 7
   6. Cells arranged in rows throughout entire thallus 8
7. Thallus tubular; membrane over 20 μ thick, with cells nearer the outer surface **E. intestinalis**
7. Thallus compressed; cell membrane under 20 μ thick, with the cells in the center **E. compressa**
   8. Surface view of cells in the main axis under 20 μ in either dimension; bases of branches attenuated, filament-like; tips of branches inflated as in the main axis ..... **E. prolifera**
   8. Mature cells with 2 — 5 pyrenoids; cell rows usually about 20 μ broad; cells not strongly thickened at their adjoining angles ..... **E. clathrata**
9. Mature cells with 1 pyrenoid; cell rows usually about 10 μ broad; cells often strongly thickened at their adjoining angles ..... **E. Ahlneriana**

Enteromorpha intestinalis (L.) Link, 1820:5; — Setchell & Gardner, 1920b:252; — Smith, 1944:49. *pl. 5, figs. 4–6.*

A number of collections have been made between the mouth of the Nehalem River and Brookings. Two (*MD 6136c*, fresh lake in beach of Chetco Cove; and *6219*, Otter Point) are the variety (form) *clavata* of J. Agardh. *Enteromorpha intestinalis* is found along high-tide line near fresh water sources, on rocks near seepages or near the mouths of rivers and creeks.

Distinguished from other species found along the Pacific Coast of North America by the irregular arrangement of cells and by the cells lying nearer the external surface of the membrane. Kylin (1907:7) states that this latter characteristic serves as a ready distinction between this species and *E. compressa*, the membrane of which is at times slightly thicker on the inner face. In addition, the membrane in *E. compressa* is usually thinner (under 20 μ thick).

Enteromorpha compressa (L.) Greville, 1830:180. *pl. 18*; — Setchell & Gardner, 1920b:251. *pl. 14, figs. 7–8*; *pl. 16, fig. 3*; — Smith, 1944:52. *pl. 5, fig. 7.* (Both in part)

Thalli light green, with many narrow oblanceolate branches arising from constrictions in the narrow oblanceolate main axis; up to 30 cm. tall, the upper portion of the branches up to 5 mm. broad; inflated in some areas but mostly compressed, cells thin-walled, squarish or elongate in surface view, up to 16.5 x 18 μ, in longitudinal rows in the narrowest portions of the stipe; above this the cells are rounded to polygonal, irregularly arranged, about 16 μ in diameter with the membrane up to 8 μ in thickness and with the cells in its center.

Throughout the range, the largest and most proliferous thalli (*e.g.*, *MD 4853*, Charleston) most abundant on woodwork in protected habitats. In these thalli the cells are in well-defined rows both in the stipes and narrower portions of the blade. Thalli with few or no branches may have the cells irregularly arranged except in the lowermost two centimeters (*O'Neal 252*, Coos Bay; University of California herbarium collected by A. R. Sweetser (*5*) at Seal Rocks and determined by Setchell). Gardner. *2766*, made a collection of this species from the entrance to Coos Bay that has been referred by Setchell & Gardner (1920b:252) to the variety *subsimplex* J. Agardh.

Enteromorpha prolifera (Müller) J. Agardh, 1883:129. *pl. 4, figs. 103–104*; — Setchell & Gardner, 1920b:254; — Taylor, 1937: 65. *pl. 3, fig. 2*; — Bliding, 1939:134. *figs. 1–3.*

Thallus dark to light green; with a distinct main stem which is either simple and often broad, or more or less richly proliferous; stipes usually attenuated to filament-like proportions basally; cells 8–18 x 7–13 μ, cells in the lower portions of the thalli mostly squarish or rectangular in surface view, cells in the proliferations in distinct, often oblique, rows that become less distinct in the upper parts of the main axes and where too the cells become more rounded-polygonal, with one central pyrenoid; mem-

brane 14–18 μ thick; male gametes 5.7–2.2 μ; female gametes 6.2 x 2.9 μ; zoospores 9.1 x 4.4 μ (average sizes for all three).

Throughout the range in a confusing array of forms. In general this species is distinguished by having inflated or tubular fronds with the cells in rows, the cells centrally located in the membrane, smaller than those of *E. compressa*, with very thin walls, and the stipes not at all "attenuated" as compared to those of the most branched forms of *E. compressa*. There is a collection in the University of California herbarium (*Gardner 2767*) from North Bend that macroscopically seems more like a proliferous specimen of *E. intestinalis* or *E. compressa*. Another Oregon collection (*MD 4915*) has tubular coiled or flexuose thalli up to 5 cm. long — this was collected from an almost fresh-water pool at the plus 8.0 foot level along Coos Head in July.

On the basis of interfertility and intergradation of forms found in Scandinavian waters, Bliding combines *E. prolifera* (Fl. Dan.) J. Agardh, *E. flexuosa* (Wulf.) J. Agardh, *E. tubulosa* Kützing, *E. intestinalis* (L.) Link forma *prolifera* Hauck, and *E. compressa* (L.) Ahlner; — *non E. compressa* (L.) Greville. His opinion is followed here except that *E. flexuosa* is considered a distinct variety of *E. prolifera*. The above description is taken in part from Bliding's paper.

Enteromorpha prolifera var. **flexuosa** (Wulf.) comb. nov.

Enteromorpha flexuosa (Wulf.) J. Agardh, 1883:126; — Setchell & Gardner, 1920b:255; — Taylor, 1942:13.
Enteromorpha compressa var. *flexuosa* (Wulf.) Hamel, 1931:65.

Thalli simple, inflated, up to 2 cm. tall; cells in irregular rows, averaging 11 μ in diameter, rectangular, centrally located in the cell membrane which is about 9 μ thick; cell walls very thin.

At MLLW and above on sloping, exposed rocks at Sunset Bay. The determination of *MD 4840* has been confirmed both by Bliding and by Sjöstedt.

Enteromorpha Ahlneriana Bliding, 1944:345. *figs. 10–18.*

Enteromorpha crinita Setchell & Gardner, 1920b:258 in part; *non* (Roth) J. Agardh.

Thallus dark to pale green; varying from profusely and finely branched narrow forms to sparingly branched broad forms; 2–40 cm. high; cells in longitudinal rows and, sometimes, in transverse rows, from about 30 x 10 to about 23 x 10 μ, rectangular and for the most part with rounded corners, cell walls often strongly thickened, chromatophores as a rule well-developed though sometimes small, on an average only one large pyrenoid per cell; alternation of generations unknown; the 4-flagellate zoospores about 9.2 x 3.8 μ.

The above description is based for the most part on the original by Bliding and upon a collection (*Gardner 2730*, North Bend) determined by Bliding as this species. Another collection (*MD 2739*) was obtained from the south jetty of the Nehalem River.

Enteromorpha clathrata (Roth) Greville, 1830:181; — Setchell & Gardner, 1920b: 260; — Bliding, 1944:331. *figs. 1–9.*

Enteromorpha erecta (Lyngbye) J. Agardh, 1883:152; — Setchell & Gardner, 1920b:259.

Enteromorpha plumosa Kützing, 1843:300. *pl. 20, fig. 1*; — Setchell & Gardner, 1920b:259.

Enteromorpha crinita Setchell & Gardner, 1920b:258.

Enteromorpha salina Setchell & Gardner, 1920b:257.

Thalli pale to dark green, especially at the base, richly and mostly finely branched; branches hair-like or broader, with monosiphonous or polysiphonous apices; cells arranged in longitudinal rows, those in the main axis very large, from about 20 x 30 μ–20 x 50 μ, rarely only about 8 x 13 μ; cells in the lateral branches quadrate or rectangular; chromatophore usually small in proportion to size of cell; usually with 2–5 pyrenoids in mature cells; alternation of generations present; biflagellate male gametes averaging 2.5 x 5.5 μ; biflagellate female gametes averaging 2.8 x 6.3 μ; quadriflagellate zoospores averaging 4.3 x 9.8 μ, often with 2 pyrenoids.

Throughout the range in a wide variety of forms.

The above description is taken for the most part from Bliding's paper.

On the Pacific Coast Setchell & Gardner recognized three species (*E. crinita*, *E. erecta*, and *E. plumosa*) which they thought differed from *E. clathrata* in the character of the young branches and in the extent to which the chloroplasts covered the cell surfaces. In accordance with the age of the thallus or the effect of its physiological condition upon its morphology, different parts of the same thallus of *E. clathrata* may be referred to either *E. crinita*, *E. erecta*, or *E. plumosa*. Such has been found to be the case in the collection *MD 2756* (beach north of the Siuslaw River) and *O'Neal 447* (lower Coos Bay).

This species begins its development as attached delicate tufts, quite *Cladophora*-like in nature, in the bays or in other sheltered waters. As these tufts grow larger and mature they break away from their substratum and develop into free floating masses which are often several yards in extent; drifting together in large entangled masses, they often become caught about the piling in bays and river mouths. The masses may become freed, washed out to sea, and eventually cast ashore on open ocean beaches.

All stages described above have been found along the Oregon coast. The youngest material collected (*MD 4113*, Middle Bay in January) formed a low, 0.5 cm. tall, bunchy, coating on the sides of shallow tide pools in sedimentary rocks protruding near the plus 10.0 foot tide level. These were intermingled with strands of *Ulothrix implexa*. Free-floating fronds have been collected in later seasons from at least as far north as the Nehalem River, in Coos Bay, and at the Rogue River Reef (*MD 6221*). The major branches of this form are frequently a millimeter in diameter. In the Nehalem River collection there were areas in some filaments where the cells were filled with bodies thought to be immature swarmers.

Enteromorpha minima Nägeli *in* Kützing, 1849:482; — Kützing, 1856:16. *pl. 43, fig. 3* (of type); — Sjöstedt, 1939:18. *fig. 1* (figures and description of type); — Bliding, 1938:84 ff. *figs. 1–6*; — Ahlner, 1877:48; — Setchell & Gardner, 1920b: 250; — Smith, 1944:50. *pl. 5, fig. 8.*

Enteromorpha micrococca Kützing, 1856:11. *pl. 30, fig. 2*; — Sjöstedt, 1939:21. *fig. 2* (of type); — Setchell & Gardner, 1920b:249; — Smith, 1944:50.

Enteromorpha nana Sjöstedt, 1939:35.

Enteromorpha nana var. *minima* (Nägeli) Sjöstedt, 1939:38.

PLATE 3, FIGS. 1–4

Thalli unbranched; yellowish green to dark green; inflated, 0.5–2.0 cm. high or rarely up to 7 cm. when growing in protected localities, and usually less than 2 mm. broad; cells rounded polygonal, 5–7 μ in diameter, with one pyrenoid, centrally located in membranes less than 10 μ thick but in thick membranes (over 10–16 μ) somewhat nearer the outside, usually irregularly arranged, but in tall narrow forms in irregular rows or irregular spiralled rows; sexual reproduction unknown; asexual reproduction by means of quadriflagellate zoospores approximating 5.5 μ in length, without a stigma and not phototactic; juvenile thallus becoming a plate of cells two cells thick in the center, from which the adult thalli arise as one or a few proliferations.

Common on high surf-swept rocks and on mussel shells (*Mytilus* spp.) throughout Oregon.

Kützing described *E. minima* in 1849 and *E. micrococca* in 1856. Ahlner, the next phycologist to monograph the genus, reversed the names when redescribing Kützing's two species and this error has persisted in phycological literature until Sjöstedt re-examined the types of Kützing's species in 1939. Both species have been recognized by Collins and other American phycologists. With respect to these two species, I have followed the opinion of Bliding who holds that they are but one species. The identification of *MD 4992* as *E. minima* has been confirmed by Bliding, and by Sjöstedt under the name *E. nana.*

Enteromorpha minima var. **subsalsa** (Kjellman) comb. nov.

Enteromorpha micrococca f. *subsalsa* Kjellman, 1883:359; — Setchell & Gardner, 1920b:249. *pl. 16, fig. 1.*

Enteromorpha nana var. *subsalsa* (Kjellman) Sjöstedt, 1939:53.

Enteromorpha clathrata f. *uncinata* Kjellman, 1877:44; — Kjellman *in* Wittrock & Nordstedt, Alg. Exsicc. 131.

Enteromorpha arctica J. Agardh, 1882–1883, *pro parte, fide* Sjöstedt, 1939:53.

Enteromorpha minima var. *rivularis* Collins, 1909b:201.

In creek mouths throughout the range from Short Sand Beach (*MD 2721*) to Chetco Cove.

The cells of Oregon specimens are irregularly arranged, the cell lumina rounded in outline and 6–9 μ in one dimension, though sometimes narrower in the other. The cell lumina are nearer the outer surface of the membrane which is usually at least 12 μ thick. There are numerous irregularly arranged compressed blunt branches with very broad bases — but the branching is not confined entirely to the margins. The chloroplast does not cover

the cell surface completely when herbarium material is remoistened. It seems identical with Kjellman's description (1883) and figure (Plate 31, Figs. 1–3). Both Drs. Sjöstedt and Bliding have confirmed the determination of *MD 2721.*

Enteromorpha linza (L.) J. Agardh, 1883:134. *pl. 4, figs. 110–112.*
Ulva linza Setchell & Gardner, 1920b:262; — Smith, 1944:44. *pl. 3, figs. 4–5.*

PLATE 1, FIGS. 7–9

Common throughout the range in one form or another.

Bliding (1939:140), and earlier J. Agardh, pointed out that *U. linza* is distinguishable from other narrow unbranched species of *Ulva* and *Enteromorpha* by the arrangement of the cells in rows near the base, and Bliding adds that the swarmers are always four-flagellate zoospores. In other related species the cells are irregularly arranged and the swarmers are biflagellate. *E. linza* is to be differentiated from *E. angusta* by its thinner blades, proportionally broader cells, and simpler, less plicate frond (except some *E. linza* var. *crispata*). The varieties of *E. linza* having blades as thick as those of *E. angusta* are differentiated by their shape, color, and in habitat.

At the time Linnaeus established the name "linza" as the specific name there was no genus after which it could have been taken. He refers to Johann Bauhin's *Historia plantarum universalis.* . . . 1650–1651, vol. 3, p. 801 (not p. 81 or otherwise as usually cited). Here *Fucus linza* is described in a small paragraph at the bottom of the upper half of the right hand column as follows: "Fucus Linza dictus Lactucae marinae similis," as a centered italicised heading, followed by: "Fucus Linza dicta, Lactucae marinae similis: sed in eo differt quod tota in fascias (Linze) longas diuisa sit, eodum Imper. authore cap. 12." The capitalization is as in the original. Insofar as the author has been able to ascertain by consultation with Italian, Greek, and Latin philologies he has found no justification for the capitalization of this specific name. There is no indication in the original or elsewhere that it might be a patronym.

KEY TO THE VARIETIES OF *E. LINZA* FOUND IN OREGON

1. Upper portion of blades usually less than 15 μ thick; cells up to 3 or 4 times as broad as tall in cross section 2
1. Upper portion of blades usually over 25 μ thick; cells not more than twice as broad as tall in cross section ..... **E. linza** var. **oblanceolata**
2. Blade linear, marginally plicate ..... **E. linza** var. **crispata**
2. Blade linear to narrowly elliptical-oblanceolate, margin not plicate 3
3. Stipe straight ..... **E. linza** var. **lanceolata**
3. Stipe flexuous or coiled ..... **E. linza** var. **flexicaulis**

Enteromorpha linza var. **lanceolata** J. Agardh, 1883:134.

PLATE 1, FIGS. 7–9

Throughout the range, on rocks between LHLW and MLLW.

The Phycotheca Boreali-Americana number 16, from volume 1, in the

herbarium of W. R. Taylor as numbered 10389, and elsewhere, annotated by W. A. Setchell, has, in addition to the narrowly linear form with the narrow cuneate bases, low broad cells in the upper regions and there the whole blade is 18 μ or less thick. Though small in stature, this seems to represent well the conception of the variety as understood on the Pacific Coast.

Enteromorpha linza var. **crispata** J. Agardh, 1883:134.

Throughout the range, epiphytic and on rocks between LHLW and MLLW.

This variety has been collected (*O'Neal 450*) on the beach near Charleston, in not greatly different habitats from the variety *lanceolata* (*e.g.*, *MD 4630*) growing nearby.

Enteromorpha linza var. **flexicaulis** var. nov.

Frondes simplices, inflatae, lineari-oblanceolatae, usque ad 0.6 cm. latitudine atque 35 cm. longitudine, subvirides, stipitibus attenuatis helicoideis praeditae; membranae supra tenuissimae, quarum stratis duobus simul ab 3–7 μ crassitudine, e cellulis infra in ordinibus indefinitis, et in regionibus apicalibus, vel maximis, in ordinibus irregularibus compositis; infra membranae simul usque ad 25 micra crassitudine, cellulis fere quadratis; cellulae a superficie visae ab 11–14 x 12–19 μ et, regionibus basalibus exceptis, magna ex parte breviores quam 3 plo latiores quam altae, inter superficies membranae internas atque externas propemodum centraliter positae; regio fertilis solum ad apicem et superficies marginales in triente superiore thalli limitata.[3]

Fronds simple, inflated, linear-oblanceolate, up to 0.6 cm. broad and 35 cm. long, light green in color, with attenuated coiled stipes; membranes above very thin, the two layers together from 3–7 μ thick, composed of cells in definite rows below and in irregular rows even in the largest apical regions; below the membranes may together be 25 μ thick with the cells almost square; the cells are in surface view from 11–14 x 12–19 μ and in almost all cases lower than 3 times as broad as tall except in the basal regions, approximately centrally located between the inner and outer surfaces of the membrane; fruiting area confined to tip and marginal areas in the upper third of thallus.

Two collections (**TYPE:** *MD 4622*, Old Dock in Coos Bay, July 2, 1942; **COTYPE:** *MD 4991*, North Bay, July 28, 1942) have been made from rocks in relatively protected areas along the Oregon Coast. In the University of California herbarium there are several collections (*Minnie Reed 487*, *312*, and *452*) from the Hawaiian Islands that are the same, at least superficially.

Enteromorpha linza var. **oblanceolata** var. nov.

PLATE 1, FIGS. 10–11; PLATE 8, FIG. B

Frondes oblanceolatae usque ad 13 cm. altitudine per 5 cm. latitudine; stipes tenuis, tubularis aut stratis cellularum adhaerentibus; cellulae a sectione transversa visae

[3] The author is indebted to Dr. Hannah Croasdale of Dartmouth College for the Latin diagnoses.

ubique altiores quam latae, et cellulae in marginibus altiores quam illae in centro laminae; frondes in apice 45–65 μ crassitudine.

Fronds oblanceolate up to 13 cm. tall by 5 cm. broad; stipe slender tubular or with cell layers adherent, but if so then with many cells (5–6) forming the margin which is thicker than the center and with a small empty or gel-filled space between the cell layers; cells taller than broad throughout and those at the margins taller than those in the center of the blade; apically the fronds are 45–65 μ thick in the type.

TYPE: *Orla R. O'Neal 433* (Dudley Herbarium 306409), collected at Seal Rocks, Lincoln County, Oregon, VII–8–'44; epiphytic on *Gymnogongrus linearis* and there associated with *Phaeostrophion irregulare*.

This is one of the entities to be found in herbarium folders labeled *E. linza* and as yet to be distinguished chiefly by the shape of the thallus. Specimens examined from elsewhere along the Pacific Coast and from the East Coast are quite variable in the thickness of the membrane. In some of the largest specimens the cells may be square or in the thinnest parts a little broader than square. While our specimens are thick as indicated in the description above, other much larger material (*W. A. Setchell & H. E. Parks*, Sooke Harbor, Vancouver Island, B. C., June) of the same general superficial appearance was only 19 μ thick near the apex. Here none of the cells were broader than twice their height. Other large material sectioned was at the thinnest above some 35–45 μ thick, with cells cuboidal or taller.

Of a portion of the type, Sjöstedt, in a personal communication, says, "possibly it is identical with the original *Ulva lanceolata* Linne (but not identical with the *lanceolata* of later authors!!). The type is as yet not distinctly described." The punctuation and parentheses are his. It is to be hoped that perhaps Sjöstedt will publish a careful study of the Linnean species in the near future, for he says this same form is very much like some of the smaller plane forms of *E. linza* found, sometimes intermixed, on Swedish coasts.

Enteromorpha angusta (Setchell & Gardner) comb. nov.

Ulva angusta Setchell & Gardner, 1920b:283. *pl. 27; pl. 31, fig. 1*; — Setchell & Gardner, 1920b:264. *pl. 22; pl. 26, fig. 1*; — Smith, 1944:45. *pl. 4, figs. 1–3.*

PLATE 1, FIGS. 1–6

Known from Oregon by the following collections: *MD 2728*, Oceanside; *MD 2645*, Boiler Bay; *MD 2701* and *O'Neal 443*, both lower Coos Bay; *O'Neal 210*, North Bay; *MD 6294*, Otter Point; *MD 6217*, Brookings, washed in on a *Nereocystis* stipe.

Setchell and Gardner give "Moss Beach, San Mateo County, California. . ." as the type locality. Near the northern end of this Moss Beach there are two or three large wave-cut rocks associated with a curved reef. The author in searching for topotype material of this species thoroughly covered this collecting area from the northernmost accessible portion south for about one mile. *Enteromorpha angusta* was found only in the area

immediately south of these large rocks and it is assumed that this must be the type locality. The alga was growing in tufts around the tidepool edges and along the edges of gravelly rills between the LHLW and MLLW levels. The particular locality is protected from rough water.

Sections of an isotype show that the margins are sometimes tubular. Specimens from Oregon agree with the type material and this topotype material in macroscopic and microscopic details as well as in habitat. In the topotype material (*MD 6058* and *6049*) there are thalli with flat stipes, stipes with hollow or thickened margins, and stipes that are tubular. Many of them have cylindrical tubular stipes up to 2 cm. in length; others have only a narrowly cuneate flattened base superficially ulvoid in nature. The margins of the blade are usually *Enteromorpha*-like but in the tallest forms the margins become more ulvoid, but still are usually slightly thicker than the center of the thallus. An ulvoid margin describes the natural edge of a thallus formed by about 3 or less cells no taller in cross section than those in the submarginal areas: an *Enteromorpha*-like margin is descriptive of the natural edge of a thallus when formed by over 3 cells which in cross section are as tall or taller than the submarginal cells. An ulvoid margin is apt to be thinner than, or of the same thickness as, the rest of the thallus, but enteromorphoid margins are thicker than the submarginal region of the thallus.

As seen in cross section, cells in the base are approximately three times as tall as broad; whereas those in the upper portions of the blades are usually only slightly taller than broad. The upper part of the thallus of the topotypes is 21–35 μ thick. In the isotype material sectioned it was 45–50 μ thick. In surface view the cells are polygonal and sometimes in irregular rows. In cross sections of all Oregon specimens the breadth of cells is no more than double their height in any part of the thallus. The thickness of Oregon specimens varies from 20 to 50 μ but usually ranges between 25 and 35 μ. The thickness of the terminal portions of fronds and the cell shape in cross section distinguish this species from *E. linza*.

Enteromorpha vexata (Setchell & Gardner) comb. nov.

Ulva vexata Setchell & Gardner, 1920a:282. *pl. 22, figs. 4–7*; — Setchell & Gardner, 1920b:271. *pl. 17, figs. 4–7*.

Ulva californica Reed, 1902:142ff. *pl. 15* (*non* Wille).

PLATE 1, FIGS. 12–14

On the north shore of Chetco Cove (*MD 6114*) on just one boulder in July and forming a 2–foot zone running up through the upper 6 inches of the barnacles and on above to plus 8.0 or 9.0 foot tide levels (probably near LLHW); Coos Bay (*Wayne Wells 38*); Squaw Island (*MD 4140*), just above and with the highest *Porphyra*. Only the Chetco Cove specimens were infected with a fungus.

In the herbarium of Professor Wayne Wells there is a collection of a small ulvoid alga from Coos Bay which Setchell determined as this species.

Duplicates of this are in the University of California herbarium and in the author's collection. There are two or three collections from our range and south of it in the author's collection that seem to belong here except that they are without trace of fungous infection. A collection of typical infected material was obtained in which there were a few only slightly infected thalli with the same morphology as uninfected thalli, and these bridge the gap between the infected and uninfected plants.

Sections of the base of the isotype material were swollen and appeared, as did the margin, as though this would be tubular if it were not for the filling by fungous hyphae. Cells at the margins of this material are arranged in typical enteromorphoid style and are taller than those on the flat surface of the thallus. The uninfected collections always possess thalli in which tubular enteromorphoid margins can be found.

SCHIZOGONIALES
SCHIZOGONIACEAE

PRASIOLA Meneghini, 1838

Prasiola meridionalis Setchell & Gardner, 1920a:291. *pl. 25, fig. 2*; — Setchell & Gardner, 1920b:278. *pl. 20, fig. 2*; — Smith, 1944:53. *pl. 2, figs. 10–15.*

This species grows in large patches or bands on the bird-dung bespattered offshore rocks along our coast from Puget Sound to the Monterey Peninsula. The bands are often five to ten feet broad extending upwards from the highest tide levels. Growths of this species are particularly lush on portions of the rocks least exposed to desiccation and most exposed to spray, thus suggesting that these two factors are additive. While these green bands have been observed in our range on offshore rocks, the only actual collection was one small thallus found incidentally in beach wash south of the mouth of the Chetco River.

CLADOPHORALES
CLADOPHORACEAE

CLADOPHORA Kützing, 1843

Cladophora delicatula Montagne, 1850:302; — Setchell & Gardner, 1920b:220; — Smith, 1944:61.

PLATE 4, FIG. 2; PLATE 3, FIGS. 5–7

Known only from a single collection (*Gardner 2747*) bearing the annotation, "Growing on sound rock in a sheltered shady place near high tide, North Bend, Oregon. May, 1914."

This species is distinct from all others in the method of development of trichotomous branches. While this method does not always obtain, it is common in all the material examined. The illustration was drawn from a part of Gardner's collection.

Cladophora hemispherica Gardner & Collins, *apud* Collins, 1918:83; — Setchell & Gardner, 1920b:209; — Smith, 1944:57.

PLATE 4, FIG. 1

Known in our range only from South Cove.

All specimens identified by Setchell & Gardner as this species are from central California. Along the Oregon coast there seems no clear distinction between this species and *C. trichotoma*. However, a lower, more closely tufted, sand-free, dichotomous form with smaller branches is considered this species. On Cape Arago it grows at higher levels and in more exposed situations than does *C. trichotoma*. None of the Oregon specimens is over 1.5 cm. tall and very few branches are over 135 μ in diameter. The lowermost cells of the thallus (*MD 2696*) are up to ten times as long as broad. The apices of the branches are short-acute. Similar material has been collected near the type locality (Cypress Point, Monterey Peninsula, California). The figures have been drawn from a portion of Gardner's collection *4620* made at Moss Beach, San Mateo County, California. The often swollen abaxial surface of the branch base is a feature distinctive of this alga (see figure).

Cladophora trichotoma (C. Agardh) Kützing, 1849:414; — Setchell & Gardner, 1920b:210. *pl. 16, fig. 2*; — Smith, 1944:58. *pl. 7, fig. 2.*

This *Cladophora* is abundant at all stations along the coast and is identifiable in the field by the size (2–4 cm. tall) and its hemispherical, usually somewhat sand-choked, tufts which grow between HHLW and LHLW.

A very coarse wiry form is present around high-lying tidepools and at similar heights in moisture-retaining crevices. This (*e.g., MD 4159*) seems distinct from all other species of *Cladophora* described by Setchell & Gardner, but since the species of *Cladophora* are so poorly understood it is felt best to consider this merely a form of *C. trichotoma* rather than a new and distinct entity. It forms loosely tufted mats 1 or 2 cm. in thickness; all branches are straight and of about the same diameter; the cells are up to 270 μ in diameter and 2.5–3 diameters in length.

Cladophora gracilis (Griffiths & Harvey) Kützing, 1845:215; — Taylor, 1937:89. *pl. 5, figs. 1–2, 6–7.*

One collection (*O'Neal 243*) from the old jetty at the mouth of South Slough is undoubtedly this species.

The largest filaments are 150 μ in diameter with the cells up to 300 μ (or perhaps more) in length. The branching is not at all opposite or dichotomous, but alternately two or three times unilateral. The tips are subacute with the smaller ramuli incurved.

Cladophora microcladioides Collins, 1909a:17, *pl. 78, figs. 2–3*; — Setchell & Gardner, 1920b:212. *pl. 13, fig. 2*; — Smith, 1944:59. *pl. 7, fig. 3.*

Setchell & Gardner list this species as ranging from Vancouver Island to San Diego. Only a single small collection by Mrs. H. B. Yocom from Coos Bay admits this alga to the flora.

SPONGOMORPHA Kützing, 1843

Spongomorpha coalita (Ruprecht) Collins, 1909b:361; — Setchell & Gardner, 1920b: 230. *pl. 16, fig. 4*; *pl. 32*; — Smith, 1944:65. *pl. 6, fig. 1.*

This is the most abundant and constantly present filamentous green alga throughout our range.

Spongomorpha Mertensii (Ruprecht) Setchell & Gardner, 1920a:280; — Setchell & Gardner, 1920b:227.

PLATE 6, FIGS. 10–12

On *Phyllospadix* at North Bay (*MD 5059*) and in a tidepool at South Bay (*MD 2283*). This species has also been collected at Coos Head (*MD 2010*).

This species, other than *S. coalita*, is the only Pacific Coast *Spongomorpha* with compound hooked branchlets. Oregon material compares well with specimens determined by Setchell & Gardner and is to be distinguished from *S. coalita* not only by its blunter branch tips but also by the less branched and less entangled nature of the whole frond. In addition, at least one collection has the young branchlets stiffly erect from their origins, so that they are, within the length of the lowermost cell, bent parallel to the parent filament. While the branches are initiated from the upper ends of cells in the main filament these cells continue to lengthen apically so that soon the older lateral branches seem to have arisen from the middle portion of the cell. In many cases the hooked branchlets in older parts of the thallus seem to have arisen, then, below the middle of the parent cell. Sometimes the branching is opposite with the branches unequal.

Spongomorpha saxatilis (Ruprecht) Collins, 1909b:360; — Setchell & Gardner, 1920b:226.

Only one collection known from Oregon (*MD 2003*, South Bay).

The Oregon collection fits well the description given by Collins. The filaments are near 90 μ in diameter, often oppositely branched, with the branches somewhat acute and not hooked.

Spongomorpha duriuscula (Ruprecht) Collins, 1909b:356; — Setchell & Gardner, 1920b:225.

The one collection (*MD 2645*, Boiler Bay, July) resembles *S. hystrix* in forming a low indefinitely limited mat. The cells show rather distinct longitudinal striations with the branching predominantly unilateral to irregularly alternate. The cells are up to 225 μ in diameter and 2.5–3 times as long as broad. There are no hooked or spiny branches and the tips are blunt. For these reasons the collection has been identified as *S. duriuscula* rather than as a form of *Cladophora trichotoma*, even though its mat-like thallus is atypical.

Spongomorpha spinescens Kützing, 1849:418; — Kützing, 1854:16. *pl. 75*; — Setchell & Gardner, 1920b:229.

PLATE 5, FIGS. 1, 5–6

There are four collections from the coast of Oregon: *MD 4550*, Sunset Bay; *MD 6295*, Rogue River Reef; *Wayne Wells 29*, Coos Bay; *MD 2011*, South Bay.

The main axes have gradually enlarged blunt tips, many acutely tipped spiny branches below and a few simple hooked branches; the tips of secondary axes are mostly blunt but some are spiny tipped. The filaments are up to 160 μ in diameter at the tips and the branching is alternate or secund. The rhizoids are often acutely tipped and on the longer ones there are lateral branches. Cells in the basal portion of main filaments are 1.5–2 times as long as broad, above this up to 4 diameters long, and those in the apical region may reach a length of 10 diameters. Cells below the tips are in irregular pairs indicating intercalary cell division. While the specimens are considerably coarser than usual for the species, examination of a considerable amount of each collection has shown no branched hooked-branchlets, and there are always the spiny, acutely tipped, lateral branches and the main branches with the enlarged blunt tips characteristic of this species.

RHIZOCLONIUM Kützing, 1843

Rhizoclonium tortuosum (Dillwyn) Kützing, 1845:205; — Setchell & Gardner, 1920b:185; — Smith, 1944:62.

Collected at Coos Bay by Mrs. H. B. Yocom, and entangled with *Rhodomela larix* along the north shore of Chetco Cove (*MD 6118*, July).

Rhizoclonium riparium (Roth) Harvey, 1849:238; — Setchell & Gardner, 1920b: 182; — Smith, 1944:63. *pl. 7, fig. 4.*

The presence of this species in our range (Sanborn & Doty, *ined.*) is based on somewhat questionable records, for while several of our collections fulfill the requirements of this species, there seems to be perhaps little real difference between this and the following three species.

The species grows along the highest tide lines on banks and cliffs. In such places Setchell & Gardner report it to form "skein-like masses." *Rhizoclonium implexum* (Dillwyn) Kützing may be a form of this species growing attached in more strictly aquatic habitats, habitats favorable to more rapid growth, the production of fewer and simpler rhizoids, and the formation of larger cells in straighter filaments. Many of the specimens in the folder of the University of California herbarium consist of erect rather parallel filaments 10–15 cm. high that evidently grew attached. Setchell & Gardner's *R. lubricum* may be a form of this species also, a form which grows at even lower levels than *R. implexum* or becomes free floating. Its filaments are straight; the rhizoids are rare and very simple.

Rhizoclonium lubricum Setchell & Gardner, *apud* Gardner, 1919:492. *pl. 42, fig. 5*; — Setchell & Gardner, 1920b:185. *pl. 9, fig. 5.*

In our range known only from Coos Bay.

Three Oregon collections are referred to this species since they are distinguishable from the rest by their long lubricous filaments, more delicate cell walls, and much less dense chloroplasts. One collection (*MD 2232*) was found attached to *Fucus* in upper Coos Bay and the other two (*MD 4922* and *4621*) were floating as large mats four to six feet in diameter in lower Coos Bay. The collection *4621* has thick-walled cells and filaments that are up to 90 μ in diameter. However, it is in other respects quite like the other two collections referred to this species. (See the note under *R. riparium* for a comparison of the species.)

Rhizoclonium implexum (Dillwyn) Kützing, 1845:206; — Setchell & Gardner 1920b:183; — Smith, 1944:62. *pl. 8, fig. 3.*

The cell walls in the one collection from Sunset Bay are often separated from each other, so that the cells resemble boxes with convex ends enclosed within a sheath. (See note under *R. riparium* for a comparison with other species.)

UROSPORA Areschoug, 1866

Urospora doliifera (Setchell & Gardner) comb. nov.

Hormiscia doliifera Setchell & Gardner, 1920a:297; — Setchell & Gardner 1920b: 193.

PLATE 7, FIGS. 3, 5, 8

Cells frequently with a breadth 3–4 times the length; the filaments decidedly clavate, often from (25)–40–60 μ in diameter at the base and up to 200 or 250 μ in the upper regions, and quite variable in diameter as Kylin (1907:18) describes for *U. incrassata*; fertile cells often spherical and 135 μ in diameter or larger; walls of largest cells 7–9 μ thick.

Along the north shore of Chetco Cove in June forming a green coating at HHLW on smooth boulders almost buried in the sand.

Urospora doliifera is of much greater diameter than *U. Hartzii* Rosenvinge, which also has different cells and more clavate filaments. Similarly or in individual respects it differs from *U. crassa* and *U. incrassata*.

Urospora grandis Kylin, 1907:18. *text fig. 3.*

Hormiscia grandis (Kylin) Setchell & Gardner, 1920b:195. *pl. 9, fig. 3.*

PLATE 7, FIGS. 1–2

Between HHLW and MLLW forming patches on rocks and on mussels from the south jetty of Coos Bay to Harris State Park.

Oregon material agrees with Kylin's description and illustration, except that the largest cells of the filaments are 70 μ in diameter. The cell walls in this material are about 14 μ in thickness. The filaments below are

about 25 μ in diameter. This species differs most conspicuously from *U. collabens* in that that species is up to 450 μ in diameter.

Urospora penicilliformis (Roth) Areschoug, 1866:16; — Smith, 1944:64. *pl. 6, figs. 2–3.*

Hormiscia penicilliformis (Roth) Fries, 1835:327; — Setchell & Gardner, 1920b: 191. *pl. 9, fig. 4.*

PLATE 7, FIG. 4

Above HHLW throughout the range on rocks and woodwork, often growing intermingled with *Bangia vermicularis*.

Differing from other Oregon species in having, in addition to extramatrical rhizoids, cells with relatively thin walls and filaments that are rather uniform in diameter throughout their length. Material collected at Otter Point (*MD 6181a*, and *MD 6224*) has filaments up to 100 μ in diameter, with spherical fertile cells.

Urospora Wormskioldii (Mertens) Rosenvinge, 1893:920. *fig. 36.*

Hormiscia Wormskioldii (Mertens) Fries, 1835:328; — Setchell & Gardner, 1920b: 196.

PLATE 7, FIG. 9

Found once (*MD 2006*, June) at Coos Head in a high tidepool. The individual filaments were growing free from each other.

Filaments usually up to 6 cm. tall but some individuals up to 20 cm. and gradually tapered to the base which is attached by intramatrical rhizoids from the last 15–30 cells. In young filaments, the cells are cylindrical throughout. In old filaments, cell divisions in the lower portions give rise to short doliiform cells shorter than their diameter; cells in the apical region swell until spherical, and are up to 850 μ in diameter. The youngest filaments seen, in which the cells were about as long as broad and cylindrical in outline, were 33 μ in diameter and evenly of this diameter throughout. Chloroplasts in both the youngest and oldest filaments are loosely reticulate.

ZYGNEMATALES
ZYGNEMATACEAE

ZYGNEMA C. Agardh, 1824

On stones in the mouth of a creek one-quarter mile south of Harris State Park there is a sterile fresh water species of *Zygnema* in an area reached by the highest spring tides.

CHLOROCOCCALES
ENDOSPHAERACEAE

CHLOROCHYTRIUM Cohn, 1872

Chlorochytrium inclusum Kjellman, 1883:320. *pl. 31, figs. 8–17*; — Smith, 1944: 67. *pl. 8, fig. 2.*

Cells of this species were found in abundance in several collections of *Dilsea californica* (*e.g.*, *MD 6102j*, washed in south of the Chetco River,

July) where they were embedded in the cortex and subcortex. The cells were up to 180 μ broad and usually about 120 μ tall. While the portion of the cell wall towards the thallus surface was thickened, there was no mammillate protuberance to be observed. Since only herbarium material was available for examination this lack of a protuberance might be due to the method of treatment, or this might be a distinct form.

Chlorochytrium porphyrae Setchell & Gardner, *in* Gardner, 1917:379. *pl. 32, fig. 6*; — Setchell & Gardner, 1920b:150. *pl. 15, fig. 1*; — Smith, 1944:67. *pl. 8, fig. 1.*

In *Porphyra lanceolata* and *P. perforata*, and also on *Erythrotrichia* sp. growing on *Ulva vexata*, at Chetco Cove. This is the only record of the occurrence of this species between Cape Flattery, Washington, and San Francisco. Present in abundance at this station.

SIPHONALES

HALICYSTIDACEAE

HALICYSTIS Areschoug, 1850

Halicystis ovalis (Lyngbye) Areschoug, 1850:447; — Setchell & Gardner, 1920b:155. *pl. 14, fig. 3*; — Smith, 1944:70. *pl. 9, fig. 1.*

At all stations from Cape Arago south.

The thalli are generally smaller (average diameter of mature thalli 5 mm.) than those to be found along the coast of central California. This species usually grows on vertical shaded surfaces exposed to well-aerated water.

DERBESIACEAE

DERBESIA Solier, 1847

Derbesia marina (Lyngbye) Kjellman, 1883:316; — Setchell & Gardner, 1920b:165. *pl. 15, fig. 3*; — Smith, 1944:71. *pl. 8, fig. 4.*

Ultimate branches 40 μ in diameter, those at the base 60 μ; the sporangia immature, pyriform, 180 μ long by 100 μ broad, with the narrow end attached to a slender pedicel about 40 μ long and 10 μ in diameter; the pedicels curved upwards from the point of attachment and containing a plug about 10 μ long; branching sub-dichotomous; the branches even, not constricted at their bases.

Collected once (*MD 5286*) from about the base of *Nienburgia Andersoniana* at Middle Bay, on shaded vertical LLLW rocks, July.

BRYOPSIDACEAE

BRYOPSIS Lamouroux, 1809

Bryopsis corticulans Setchell, 1899, *in* Phyc. Bor.-Amer. fasc. 13:626; — Setchell & Gardner, 1920b:160; — Smith, 1944:73. *pl. 9, fig. 3.*

Common to most stations along the Oregon coast. Found throughout the summer months just above the sand line on vertical rock surfaces that

are rather exposed to wave action. Usually between LHLW and MLLW levels; though rarely found as high as HHLW.

The specimens seen from Oregon are not as coarse as is typical of *B. corticulans* and usually have been referred to other species. Examination of the rhizoids and the arrangement of the branches shows no essential difference between such collections and the characteristic *B. corticulans* from California. In the later months of the summer and during the fall months this species is epiphytic on *Egregia* and occasionally on *Nereocystis* and *Rhodomela*. These epiphytic thalli are coarser and are more like the typical form. At the University of California there is only one collection north of central California and this is a typically coarse specimen from Puget Sound.

It might be added that in more protected habitats the branches are smaller in diameter and are predominantly distichous though becoming somewhat irregularly branched. Those which grow exposed to the surf, or on other algae, are of the coarse form typical of *B. corticulans*.

Superficially all the material of *Bryopsis*, except that collected in the most exposed situations on the Oregon coast, looks similar to West Coast specimens labeled Bryopsis hypnoides Lamouroux (1809: pl. 1, figs. 2a–2b) in both the herbaria of the University of California and of Stanford University. In the author's opinion West Coast specimens identified as *B. hypnoides* are probably growth forms of *B. corticulans*; at least they are not the same as East Coast *B. hypnoides*.

VAUCHERIACEAE

VAUCHERIA De Candolle, 1803

Vaucheria Thuretii Woronin, 1869:157. *pl. 12, figs. 30–32*; — Farlow, 1881:104. *pl 4, fig. 2*; — Nordstedt, 1886:3; — Taylor, 1937:100.

Known only from a few collections made at Charleston, Oregon, on South Slough. Here this alga forms dull blackish-green mats about 2 inches thick and often a few feet in diameter among *Salicornia* plants. In places it is covered by salt water with each of the highest of the high tides. It has also been collected on the mud flats about Humboldt Bay, Humboldt County, California (*MD 6231*). At this latter station the alga did not form such thick mats and the filaments seemed to be more or less prostrate. *Vaucheria Thuretii* has not been previously recorded from the Pacific Coast of North America.

The filaments of the Oregon collections are partially erect, forming mats about 2 inches thick, the lower part (1.5 inches) of which is dead and clogged with mud; the living and dead portions are separated by septa. Branches of two sorts: (1) stout more or less erect branches, and (2) small slender branches formed posterior to the growing part of the filament and extending laterally, binding the more erect branches together. Erect branches 80 to 100 μ in diameter; lateral branches 30 μ or less.

Vaucheria Thuretii is homothallic with the antheridia and oogonia borne in succession toward the apex of erect branches. A branch usually bears

a single oogonium and several antheridia, the most mature of which is nearest the oogonium. The antheridia are seated on a small swelling along the main branches and are developed in acropetal succession from the oogonia towards the apex. They are ovate or somewhat broadly pyriform with one apical pore and are mostly 70 μ tall and 45 μ broad at maturity. At first the oogonia are erect and broadly elliptical; as they increase in size, growth is unilateral so that the tip comes to be directed towards the nearest antheridium, at about right angles to the original axis. After fertilization the oogonium becomes more ovoid and eventually over 200 μ in its largest diameter. Mature zygotes in Oregon specimens are spherical, smooth, brownish-black, and up to 180 or 200 μ in diameter.

The oft-repeated statement that the zygotes are elliptical or ovate apparently rests upon Nordstedt's (1886:3) statement, ". . . oospores 0,12–20 m.m. broad, by 0,17 to 24 m.m. long." Woronin's original description is devoid of a description of the zygote. The type material contained no mature zygotes and the only indication of their size and shape insofar as that discussion is concerned is from the size given for the oogonia, ". . . gewöhnlich im Durchmesser 0,2 bis fast 0,3 Mm." and from the excellent colored plate which shows the antheridia and eggs or immature zygotes. The Oregon thalli have fewer antheridia but these are the same size and shape as those in Woronin's figure and description of the type.

CODIACEAE

CODIUM Stackhouse, 1797

Codium fragile (Suringar) Hariot, 1889:32; — Setchell & Gardner, 1920b:171. *pl. 28–29*; — Smith, 1944:75. *pl. 9, fig. 5.*

Throughout the range, usually forming hemispherical clumps near MLLW but the proper position in the vertical range is uncertain.

This species is often frayed as though it had been chewed by some gastropod. It is often covered by *Ceramium codicola*, but along the coast of Oregon it has not yielded the wealth of endophytic brown algae so frequently found in thalli of *C. fragile* growing along the coast of California.

Codium Setchellii Gardner, 1919: 489; — Setchell & Gardner, 1920b:168. *pl. 9, figs. 10–11, 30*; — Smith, 1944:75. *pl. 9, fig. 4.*

Found throughout the range on shaded vertical rock surfaces, such as the walls of narrow crevices. The felt-like masses of this alga are often many square decimeters in area. Usually growing between LHLW and approximately halfway between LHLW and HHLW and with the vertical distribution controlled more by exposure to sunlight than by tidal level.

PHAEOPHYTA

ISOGENERATAE

ECTOCARPALES

ECTOCARPACEAE

ECTOCARPUS Lyngbye, 1819

Ectocarpus granulosus (J. E. Smith) C. Agardh, 1828:45; — Setchell & Gardner, 1925:426; — Smith, 1944:81. *pl. 11, figs. 1–2.*

Common on the larger brown algae, buoys, rocks, and woodwork along Cape Arago and within Coos Bay.

The cortication and the opposite branchings are clearly evident in entire plants. These are often not evident in fragmentary material. In such cases the characters of most use are: (1) the size and proportionate shape of the sporangia, and (2) the major branches not being reduced in size at their bases. The largest of the Oregon specimens assume the ropy symplocoid habit of *Pterosiphonia robusta* or *Spongomorpha coalita*, and have for this reason often been identified on this coast as *E. tomentosus*.

Ectocarpus siliculosus (Dillwyn) Lyngbye, 1819:131 (in part). *pl. 43, fig. C*; — Setchell & Gardner, 1925:410.

Thalli up to 3 cm. tall, epiphytic at first but often becoming free-floating; branching alternate, older branching appearing dichotomous, with the main axes up to 60 μ in diameter, uncorticated; cells cylindrical, as short as 0.6 but more frequently of cells 1.0 to 1.5 times as long as broad; ultimate branches about 20 μ in diameter at their bases, lax and long-attenuate, of cylindrical cells up to 1.5 times as long as broad, or the cells may be slightly constricted at their cross walls; plurilocular organs developing from these ultimate branches and for the most part one cell broad, 15 to 25 μ wide and 250 μ or more long, the tip often remaining sterile or becoming hair-like.

Floating in Coos Bay (*MD 2469*) in July.

?Ectocarpus confervoides (Roth) LeJolis, 1863:75.

Gardner in his notebooks under the number *2744* lists the variety (forma) *typicus* from North Bend. This is probably the basis of Setchell & Gardner's (1925:414) report of this variety from Oregon.

Ectocarpus variabilis (Saunders) G. M. Smith, 1942:647. *figs. 1–4*; — Smith, 1944: 85. *pl. 10, figs. 2–4.*

In Gardner's notes under number *2692* there is a recording of this species from *Nereocystis*, "from Lighthouse, Cape Arago."

Ectocarpus acutus Setchell & Gardner, 1922e:404. *pl. 48, figs. 36–39*; Setchell & Gardner, 1925:415; Smith, 1944:80. *pl. 10, fig. 1.*

On kelps and *Zostera* in lower Coos Bay.

Ectocarpus acutus var. **haplogloiae** var. nov.

Ectocarpus acutus Setchell & Gardner, 1922e:404 (in part).

PLATE 8, FIG. A

Frondes usque ad 3 cm. altitudine; axes maiores infra corticati, 60 μ diametro, cellulae hic magna ex parte $\frac{1}{2}$ breviores quam latae vel minus; ramificatio infra alternata aut irregularis, supra unilateralis facta; rami ultimi 7–10 μ diametro, e cellulis subdoliiformibus, 1.2 plo longioribus quam latis, ad apices acutos gradatim attenuatis compositi; chromatophori ligulati; sporangia plurilocularia in pediculo ex una paucisve cellulis constante, 19–35 x 100–200 μ, elliptico-lanceolata.

Fronds up to 3 cm. tall; major axes below corticated, 60 μ in diameter, cells here mostly half as long as broad or less; branching alternate or irregular below, becoming secund above; ultimate branches 7–10 μ in diameter, composed of slightly doliiform cells 1.2 times as long as broad, gradually tapered to acute apices; chromatophores bandshaped; plurilocular sporangia on one or few-celled pedicels, 19–25 x 100–200 μ, elliptical-lanceolate.

On *Haplogloia Andersonii* from Neah Bay, Washington (*Gardner 3817*), Middle Bay (**type:** *MD 2491*, July 30, 1940), Brookings (*O'Neal 378b*), and Moss Beach, San Mateo County, California (*MD 6056*, in June).

While this entity differs little from the species above in microscopic dimensions, these differences are rather constant and the habitat is distinctive.

Ectocarpus pygmaeus Areschoug *apud* Kjellman, 1872:85.

Ectocarpus confervoides var. *pygmaeus* Saunders, 1898:154. *pl. 15, figs. 5–9*; — Setchell & Gardner, 1925:415; — Smith, 1944:84.

On stipes of *Laminaria Sinclairii* (*MD 2401*, Squaw Island), *Pterygophora* (*MD 1894*, North Bay), and *Nereocystis* (*MD 2339*, North Bay), all in July.

Ectocarpus terminalis Kützing, 1845:236; — Setchell & Gardner, 1925:421.

Forming small tufts or velvety circlets that enlarge and fuse into areas of indefinite extent and shape, on the stipes and blades of various kelps throughout the range.

PYLAIELLA Bory, 1823

Pylaiella littoralis (L.) Kjellman, 1872:99; — Setchell & Gardner, 1925:402. *pl. 37, fig. 32.*

One collection (*MD 4229*, September) from woodwork in Siuslaw Bay below Glenada. Gardner under the number *2746*, in his notebooks, records this species from *Fucus* at North Bend.

Pylaiella unilateralis Setchell & Gardner, 1922d:386. *pl. 42, figs. 6–8*; — Setchell & Gardner, 1925:404.

Known only from the type (*Gardner 2748*) collected on rocks near the high tide line, "Sunset Beach, near the mouth of Coos Bay, Oregon," which location probably is Sunset Bay.

RALFSIACEAE

RALFSIA Berkeley, 1843

Ralfsia fungiformis (Gunnerus) Setchell & Gardner, 1924:11; — Setchell & Gardner, 1925:499.

Dr. G. J. Hollenberg has determined this in a collection (*MD 2130*) from Middle Bay.

Ralfsia pacifica Hollenberg, *in* Smith, 1944:95. *pl. 12, figs. 4–6* (*nom. nud.*)
Ralfsia verrucosa Setchell & Gardner, 1925:497 *non* (Areschoug) J. Agardh 1848:62.

A sterile collection from Cape Arago was determined as this species by Dr. Hollenberg. The range given for this species (*i.e., R. verrucosa*) by Setchell & Gardner is "Bay of Unalaska, Alaska, to Monterey Bay, California." This is an illegitimate name for this alga.

ELACHISTEACEAE

ELACHISTEA Duby, 1830

Elachistea fucicola (Velley) Areschoug, 1842:235. *pl. 8, figs. 6–7*; — Setchell & Gardner, 1925:503. *pl. 38, figs. 33–35.*

Known only from the record published by Setchell & Gardner, and by one collection (*MD 2233*) on *Fucus evanescens* at the mouth of Haynes Slough in Coos Bay.

HETEROCHORDARIACEAE

HETEROCHORDARIA Setchell & Gardner, 1924

Heterochordaria abietina (Ruprecht) Setchell & Gardner, 1924:6; — Setchell & Gardner, 1925:550. *pl. 36, figs. 18–19*; *pl. 91*; — Smith, 1944:98. *pl. 14, fig. 3.*

Common throughout the range in the upper part of the LHLW to HHLW zone.

SPHACELARIALES

SPHACELARIACEAE

SPHACELARIA Lyngbye, 1819

Sphacelaria racemosa Greville, 1824. *pl. 96*; — Setchell & Gardner, 1925:393.

Present as sand-choked tufts in LHLW level shallow tidepools and on rocks at similar levels (*MD 2782*, Lighthouse Beach, December; *MD 4216*, December, and *MD 4713*, July, both from Brookings). Known south of Puget Sound only by these three collections.

DICTYOTALES

DICTYOTACEAE

DICTYOTA Lamouroux, 1809

Dictyota flabellata (Collins) Setchell & Gardner, 1924:12; — Setchell & Gardner, 1925:652. *pl. 34, fig. 3; pl. 35, fig. 7; pl. 36, figs. 13–17*; — Smith, 1944:101. *pl. 15, fig. 6.*

Known from two collections of specimens washed in at North Bay (*MD 5056* and *4977*, both late July).

The specimens are up to 30 cm. tall and in form like Gardner's plant (*4957*) from Ensenada, Baja California, but their color is more like his collection (*6595*) from Carmel Bay, California. Young specimens of this species are yellowish or brownish and more or less evenly colored throughout. With age and increased size the base becomes darker brown and this contrasts sharply with the more yellowish tips. There seems to be no difference between the Oregon specimens and many specimens from this coast identified as *D. Binghamiae* J. Agardh. The North Bay material seemed healthy in every respect, indicating that it was from the local area.

HETEROGENERATAE

CHORDARIALES

CHORDARIACEAE

HAPLOGLOIA Levring, 1939

Haplogloia Andersonii (Farlow) Levring, 1939:50; — Setchell & Gardner, 1925: 556. *pl. 47, figs. 8–10; pl. 48, figs. 12–14; pl. 49, fig. 17; pl. 76*; — Smith, 1944: 117. *pl. 16, figs. 1–2.*

Common throughout the range, usually around the margins of tidepools at levels above MLLW.

MYRIONEMATACEAE

MYRIONEMA Greville, 1827

Myrionema primarium Setchell & Gardner, 1922a:334. *pl. 34, fig. 12*; — Setchell & Gardner, 1925:456. *pl. 55, fig. 12*; — Smith, 1944:105.

Myrionema foecundum fa. *majus* Setchell & Gardner, 1922a:338. *pl. 32, fig. 7.*

The type locality is on the "outer end of the young blade of *Costaria costata*, mouth of Coos Bay, May"; presumably this is Sunset Bay. Also on other Laminariales along Cape Arago.

CORYNOPHLAEACEAE

LEATHESIA Gray, 1821

Leathesia difformis (L.) Areschoug, 1847:376; — Setchell & Gardner, 1925:511. *pl. 40, fig. 52; pl. 43, figs. 65–66*; — Smith, 1944:144. *pl. 15, fig. 2.*

Common throughout the range between LHLW and MLLW.

Leathesia nana Setchell & Gardner, 1924:3; — Setchell & Gardner, 1925:511. *pl. 43, fig. 67*; — Smith, 1944:115. *pl. 15, fig. 1.*

The two Oregon collections are much smaller than usual. As is typical for this species they were epiphytic on *Phyllospadix* (*MD 2332*, North Bay; *MD 6127*, north shore of Chetco Cove).

DESMARESTIALES

DESMARESTIACEAE

DESMARESTIA Lamouroux, 1813

Desmarestia latifrons (Ruprecht) Kützing, 1859:40. *pl. 95*; — Setchell & Gardner, 1925:563. *pl. 90*; — Smith, 1944:120. *pl. 18, fig. 1.*

This alga is common at two stations, Harris State Park and Sunset Bay, below the MLLW level.

The author has found no material collected in Coos Bay. Setchell & Gardner list Coos Bay as the northern limit for the species. Their statement is based on a collection by Gardner (*2669*) labeled, "Sunset Beach, Mouth of Coos Bay" but, as shown in the list of stations from which material has been collected, the locality named by Gardner lies several miles south of Coos Bay and unlike that station is a location with very little variation in salinity.

Desmarestia intermedia Postels & Ruprecht, 1840:13. *pl. 26*; — Setchell & Gardner, 1925:564.

One collection (*J. C. Queen 82*) washed ashore at Sunset Bay.

Differing from *D. latifrons* in having much narrower and more nearly terete branches. Except for some of the ultimate tips there are no aculeate spiny branches as in *D. aculeata.*

Desmarestia herbacea (Turner) Lamouroux, 1813:25; — Setchell & Gardner, 1925: 566. *pl. 88*; — Smith, 1944:121. *pl. 17, fig. 2.*

Throughout the range in well-aerated water below the LLLW level but nowhere present in quantity.

This species differs from the broader species in having several orders of branches each successively reduced in size. Unlike other broad species, the midrib of *D. herbacea* gives rise to simple veinlets that curve gently upward to the oppositely placed bladelets with only a few, if any, prominent aculeae present.

Desmarestia munda Setchell & Gardner, 1924:7; — Setchell & Gardner, 1925:567. *pl. 89*; — Smith, 1944:121. *pl. 17, fig. 1.*

Throughout the range on floating woodwork and on channel bottoms in well-aerated situations.

Most of the Oregon collections that belong to the section *Herbaceae* can be placed here. *Desmarestia munda* differs from *D. herbacea* in having a broader main axis often with the lateral veins from the midrib having

a geniculate upward curve, from the abaxial side of which a branch vein may descend. In addition, and perhaps most significantly, this species has the branches of the second order or their lateral blades much broader or more foliose (and often curved and oblanceolate) than the main axis and its lateral bladelets. *Desmarestia munda* is to be distinguished from *D. latissima* by having more orders of branches and narrower, thicker, more darkly colored fronds. In Coos Bay on the mud flats and in quiet water the thalli of *D. munda* are broader in form, thinner and lighter in color (*e.g.*, *MD 2258* and *2132*, old jetty in Coos Bay, in July) and have usually been referred to as *D. latissima*.

PUNCTARIALES

ENCOELIACEAE

ILEA Fries, 1835

Ilea fascia (Müller) Fries, 1835:321; — Smith, 1944:126. *pl. 20, fig. 4.*

Epiphytic and saxicolous (MLLW to LHLW), common throughout the range.

SORANTHERA Postels & Ruprecht, 1840

Soranthera ulvoidea Postels & Ruprecht, 1840:19; — Setchell & Gardner, 1925: 525. *pl. 39, figs. 40, 41*; *pl. 83, fig. b*; — Smith, 1944:127. *pl. 20, fig. 5.*

On *Odonthalia* and *Rhodomela* throughout the range.

COLPOMENIA Derbès & Solier, 1856

Colpomenia sinuosa (Roth) Derbès & Solier, 1856:11. *pl. 22, figs. 19–20*; —Setchell & Gardner, 1925:539. *pl. 45, figs. 82–86*; — Smith, 1944:128. *pl. 20, fig. 1.*

Common throughout the range and, insofar as observed, an epiphyte on other algae between LHLW and MLLW.

Oregon forms seem to be elements of a homogeneous developmental sequence and, therefore, their segregation into varieties has not seemed justifiable.

SCYTOSIPHON C. Agardh, 1811

The generic and specific interrelationships within the Encoeliaceae, probably a polyphyletic and unnatural aggregation, are in great need of critical study. A morphological and cytological life history study would be of great value. Particularly there has been confusion as to which genus the *Scytosiphon bullosus* of Saunders, the *Coilodesme bulligera* of Strömfelt, and the *Myelophycus intestinalis* of Setchell & Gardner belong, and as to the significance of shape, twisting and constriction in the remainder of the species of these genera. In order to make this author's current views more clear on some of these species, the following key is presented.

1. Slender, linear, sometimes complanate thalli, saxicolous in habit (*Scytosiphon*) 4
1. Finger-like or broadly inflated, epiphytic or saxicolous 2

2. With a broad, often irregularly lobed base, saxicolous ..... **Scytosiphon bullosus** Saunders

2. With a slender stipe that may be very short or sometimes nearly filamentous and conspicuous, mostly epiphytic 3

3. Saxicolous, stipe slender, elongate ..... **Coilodesme bulligera** Strömfelt

3. Epiphytic, stipe slender, very short ..... **Coilodesme californica** (Rupr.) Kjellm.

4. Fronds flattened, not constricted ..... **Scytosiphon complanatus** (Rosenvinge)

4. Fronds cylindrical, usually hollow, often constricted 5

5. Fronds over 1 mm. in diameter, usually constricted ..... **Scytosiphon lomentaria** (Lyngb.) J. Agardh

5. Fronds less than 1 mm. in diameter, not constricted ..... **Scytosiphon attenuatus** (Foslie)

Scytosiphon bullosus Saunders, 1898:163. *pl. 31, figs. 1–7*; — Smith, 1944:130.
Colpomenia sinuosa fa. *deformans* Setchell & Gardner, 1925:542.

Locally common on horizontal LHLW to MLLW rocks at South Bay (*C. L. Doty 1976*), Sunset Bay (*MD 2622*), and Brookings (*MD 2598*).

Scytosiphon lomentaria (Lyngbye) J. Agardh, 1848: 126; — Setchell & Gardner, 1925:531; — Smith, 1944:129. *pl. 19, fig. 1.*

This is the fa. *typicus* of Setchell & Gardner and is for the most part a form found in tidepools at high levels and is common throughout the range.

Two other entities occurring in our range are accorded the rank of forms by Setchell & Gardner. Since these, in addition to being quite distinct morphologically, are distinct in mode of growth habit and in habitat, they are treated below as separate species. They cannot be considered ecological variations because they occasionally occur out of their usual ecological niche.

Scytosiphon complanatus (Rosenvinge) comb. nov.
Scytosiphon lomentaria var. *complanatus* (Rosenvinge), 1893:863 (*fide* Smith); — Smith, 1944:130, in part.
Scytosiphon lomentaria fa. *complanatus major* Setchell & Gardner, 1925: 534.

PLATE 9, FIG. B

Frondes complanatae, non constrictae, usque ad 30 cm. longitudine atque 4 mm. latitudine, interdum tortae, ad basim apicemque attenuatae.

Fronds flattened, not constricted; up to 30 cm. long and 4 mm. broad; sometimes the fronds twisted and tapered toward both ends.

This species is found almost exclusively around the margins of tidepools or on floating timbers. Known from the following stations in Oregon: Seal Rocks (*A. R. Sweetser* collection in the University of California herbarium); Charleston wharves (*O'Neal 333b*, July); South Jetty of Coos Bay (*MD 1830b*, July); Squaw Island (*O'Neal 326b*, July); elsewhere in the Coos Bay and Cape Arago regions and Cape Blanco (*e.g., O'Neal 422a*, June [Dudley Herbarium *306924*]).

Scytosiphon attenuatus (Foslie) comb. nov.

Chordaria attenuata Foslie, 1887: 176, *pl. 3, fig. 3*; — Tilden, Amer. Algae 347.
Myelophycus intestinalis fa. *tenuis* Setchell & Gardner *in* Gardner, 1917: 385 (at least in part); — Collins, Holden & Setchell, Phyc. Bor.-Amer. 1919, fasc. 46:2295.
Scytosiphon lomentaria fa. *cylindricus major* Setchell & Gardner, 1925:533.
Scytosiphon lomentaria var. *complanatus* Smith, 1944: 130 (in part).
Scytosiphon lomentaria Collins, Holden & Setchell, Phyc. Bor.-Amer. 1905, fasc. 25:1235; 1907, fasc. 28: 1389; 1919, fasc. 46:2295.

PLATE 9, FIG. A

Frondes cylindricae, non constrictae, usque ad 12 mm. altitudine atque 1 mm. diametro; frons tota interdum spiraliter contorta, ad basim apicemque attenuata; frons iunior virido-brunnea, deinde, dum sporangia unilocularia maturescunt, rubido-brunnea facta; paraphyses multicellulares extra sporangia triente ad dimidium earum longitudinis excedentes.

Fronds cylindrical, not constricted, up to 12 cm. tall and 1 mm. in diameter, sometimes the whole frond spirally twisted, tapered at both ends; becoming redder brown from the young greenish brown color as the unilocular sporangia mature, enlarge (up to 47 μ tall), and become more conspicuous and thickly placed; multicellular paraphyses exceeding the sporangia by ⅓–½ their length.

Growing in more or less extensive stands between LHLW and HHLW on sloping rocks. One collection (*MD 2544* [Dudley Herbarium 306923], Coos Head, late November) formed a more or less pure stand about 2 yards broad and perhaps 10 yards long. This species characteristically grows in extensive stands rather than in isolated tufts or in tidepools. The Gardner collection *4749* from, "Cape Arago, Mouth of Coos Bay," is the same entity as is another of Gardner's collections (his *4406*) from Fort Point, San Francisco, California; though this latter is a much finer form. In Oregon other collections have been made at Cape Blanco in June and at Middle Bay (*MD 2490*) in July.

It is suspected that *Myelophycus* on the west coast of the United States is merely a twisted form of *Scytosiphon*. The type of *Myelophycus intestinalis* fa. *tenuis* (*Gardner 2649*) and isotype (*in* Collins, Holden & Setchell — Phyc. Bor.-Amer. fasc. 46: 2295) are lower in stature but otherwise the same as this species in appearance.

COILODESME Strömfelt, 1886

Coilodesme bulligera Strömfelt, 1886:48. *pl. 2, figs. 9–12*; — Setchell & Gardner, 1925:581. *pl. 45, figs. 77–78.*

In Oregon known only from Gardner's collection *2742*, "on rocks, Coos Bay, . . . Sunset Beach. . . ." This appears to be the same as the specimens from Alaska and Japan available for study. The thallus which is plane, thinnish, and inflated at first, has a delicate almost threadlike stipe, a character immediately distinguishing this species from *Scytosiphon bullosus*. While Strömfelt's figures illustrate a similar alga, there is no thick-

ened axial portion in the material seen from the northeastern Pacific area as there is in his figures.

Coilodesme californica (Ruprecht) Kjellman, 1889:4–8. *figs. 1–8*; — Saunders, 1898:160. *pl. 29, figs. 1–3*; — Setchell & Gardner, 1925:579. *pl. 46, fig.* 1–2; *pl. 86*; — Smith, 1944:131. *pl. 19, fig. 5.*

Common, coextensive with the host, *Cystoseira osmundacea.*

The largest bullate Oregon specimens of *C. californica* look very much like the cotype of *C. amplissima* Setchell & Gardner in the University of California herbarium, but not like the type specimen of *C. amplissima* which is on a different host, and may very well represent a distinct species.

PHAEOSTROPHION Setchell & Gardner, 1924

Phaeostrophion irregulare Setchell & Gardner, 1924:10; Setchell & Gardner, 1925: 586. *pl. 38, fig. 36*; *pl. 50, fig. 8*; *pl. 85.*

Locally abundant around the margins of high tidepools southward from Seal Rocks; occasionally epiphytic at MLLW levels; present throughout the year.

While the holdfasts usually appear to be discoidal some young specimens (*MD 4011*) have rhizome-like proliferations from the margin of the disc as well as a very few rhizome-like protuberances from the portion of the stipe just above the basal disc. The blades originate as knobs on the basal disc. These elongate into digitiform prolongations that broaden into the young bladelets. The stipe does not elongate as the plant becomes older and the tips of the blades seem to erode without inhibiting the general growth of the alga. From this it is assumed that the region of cell division must be at the base of the blade.

LAMINARIALES

LAMINARIACEAE

LAMINARIA Lamouroux, 1813

Laminaria saccharina (L.) Lamouroux, 1813:22; — Setchell & Gardner, 1925:595.

Common on rocks and also on floating timbers, as far south as Coos Bay, and abundant there in the lower reaches of the bay.

Laminaria cuneifolia J. Agardh, 1867:10; — Saunders, 1901:429. *pl. 50, fig. 1*; — Setchell & Gardner, 1925:600. *pl. 59, figs. a–b*; *pl. 60.*

Collected in late June and July at North Bay and Cape Blanco in the MLLW to LHLW zone (*MD 2330, 2683* and *2615*, respectively). Previously this has not been recorded south of Puget Sound, Washington. In west coast herbaria there seems to be considerable confusion between forms of this species. *Laminaria saccharina* var. *linearis* (fa. *linearis* of Setchell & Gardner), and *Hedophyllum subsessile.*

Laminaria Sinclairii (Areschoug) Anderson, 1891:220; — Setchell & Gardner, 1925:598; — Smith, 1944:135. *pl. 31, fig. 1.*
Hafgygia Sinc'airii Areschoug, 1883:6.

Common throughout the range; on rocks nearly buried in sand between MLLW and LLLW. In December the regenerating forms such as those described by Setchell (1905:139 ff. *pls. 15–17*) are found in abundance.

Since there was no description published for the material assigned under the name "Sinclairii" by any previous author, Areschoug's description is the first legitimate publication of this specific name. Anderson then made the first legitimate combination as above.

Laminaria ephemera Setchell, 1901:121; — Setchell & Gardner, 1925:603. *pl. 58.*
Renfrewia parvula Griggs, 1906:251.

PLATE 10

Thalli annual; up to 135 cm. tall; holdfast discoidal at first but with finger-like lobes proliferating from the margins of the disc; stipes of mature thalli terete, 2 mm. in diameter, in the upper portion gradually merging with the blade; stipe 10–20 cm. long, without mucilage ducts; the epidermal layer consisting of one (rarely two) low columnar cells (20–27 μ tall); blade at first narrowly cuneate; 3–7 cm. broad in the widest portion; sporangia tending to be confined to a central large sorus.

Found in abundance on *Gracilaria* and on rocks at Sunset Bay (*MD 2757*, late August; *MD 2475*, late July; *C. L. Doty* and *O. R. O'Neal 1949*, early July; *MD 4589*, June 29).

The Oregon specimens have been compared with the type of *Laminaria ephemera* and with a co-type of *R. parvula* in the University of California herbarium. They are more like the latter than the former, but certainly this species.

Laminaria Andersonii Eaton *in* Hervey, 1881:98; — Setchell & Gardner, 1925:605; — Smith, 1944:137. *pl. 21, fig. 1.*

Common throughout the range and the best indicator of the top of the upper sublittoral zone, which is arbitrarily set as LLLW.

Unfortunately Hervey in describing this alga either had very young specimens or had old specimens with only one linear segment of the blade remaining. From his description of the blade one would be inclined to think that he was referring to *L. Sinclairii*, but the statements, "where it grows on rocks with *Pterygophora*" and ". . . with the usual branching holdfast," definitely indicate that *Laminaria Andersonii*, in the usual sense, is the alga to which he refers. Young thalli are often as narrow as described by Hervey.

The characteristic tearing of the mature blades of this species into linear segments is a result of the structure of the blade. Its structure is such that it tears much more readily in a direction parallel to the lateral margins than it does across the blade. Now and then a mature specimen with an entire blade may be found in a large tidepool — these forms have the

same "tearing" characteristics. It might be expected that if other large bladed Laminarias grew in the same exposed habitats as this species these too would be similarly torn.

PLEUROPHYCUS Setchell & Saunders *in* Saunders, 1901

Pleurophycus Gardneri Setchell & Saunders *apud* Saunders, 1901:427. *pl. 52.* Setchell & Gardner, 1925:607. *pl. 80, fig. a.*

Found as isolated individuals throughout the range in the upper sublittoral (*i.e.*, up to about 5 feet below LLLW), the southernmost collection (*MD 2579*) from Brookings in June and Cape Blanco (*O'Neal 377a*).

COSTARIA Greville, 1830

Costaria costata (Turner) Saunders, 1895:57; — Setchell & Gardner, 1925:610; — Smith, 1944:138. *pl. 22, fig. 1.*

Fucus costatus Turner, 1819: *pl. 226.*
Costaria Turneri Greville, 1830:39.
Laminaria costata C. Agardh, 1820:109; 1824:269.

Throughout the range in tidepools and below LLLW or higher in protected localities.

While Setchell & Gardner and other more recent authors have not recognized two species along this coast, Saunders did earlier and, in his 1895 paper cited above, he outlines clearly both the nomenclatorial situation and the characteristics of the two entities. With very few exceptions the specimens seen during the course of this investigation are clearly one or the other of these two entities.

The slender sometimes almost linear blade of this species is comparatively smooth and never cordate at the base. The stipe tends to be broadened and flattened above with rather conspicuous costae on the surface; likewise the rhizoids are delicate and almost entirely from the very base. This species is illustrated by Turner and by Smith, though the latter's illustration is of a rather unsually broad and bullate form. Turner's figure is a fine drawing of a blade less than 5 cm. broad by about 36 cm. long; the stipe shows the characteristic form and ribbing; there are no perforations in the blade. In the text he states that the figure was prepared from a drawing made by Menzies, since the actual specimen received was too much compressed to show the ribbing and bullation well.

Costaria Mertensii J. Agardh, 1848:140; — Setchell & Gardner, 1925: *pl. 56b*; — Smith, 1944:138.

Fucus costatus sensu Mertens, 1829:43–48, *non* Turner, 1819:72. *pl. 226.*
Costaria Turneri Postels & Ruprecht, 1840:12. *pl. 24* (*non* Greville).

In exposed situations throughout the range between LHLW and LLLW; possibly restricted to the lower portion of this vertical range.

This species is well illustrated by Postels & Ruprecht and also by Setchell & Gardner, though the specimen illustrated by the latter is rather narrow at the base. The broad bullate blade of this species is much more

cordate basally than in *C. costata*, and the short, more cylindrical stipe is less conspicuously costate and often has accessory rhizoids developed from above the first-formed stoutish rhizoids.

HEDOPHYLLUM Setchell, 1901

Hedophyllum sessile (C. Agardh) Setchell, 1899, *in* Collins, Holden & Setchell, Phyc. Bor.-Amer. fasc. A: 8; — Setchell & Gardner, 1925:617. *pl. 73.*

Throughout the range, this alga is one of the conspicuous forms indicating the MLLW to LHLW zone.

Hedophyllum subsessile (Areschoug) Setchell, 1901 *in* Collins, Holden & Setchell, Phyc. Bor.-Amer. fasc. B: 27; — Setchell & Gardner, 1903: 263. *pl. 20*; — Setchell & Gardner, 1925: 618.

Collections from Cape Arago (*MD 2196* and *2213*) made in June are certainly the same as certain of Setchell's collections in the University of California herbarium (his *5078* and *3286* from Uyak and Unalaska respectively) and labelled by him as, "Hedophyllum subsessile young!"

LESSONIACEAE

NEREOCYSTIS Postels & Ruprecht, 1840

Nereocystis luetkeana (Mertens) Postels & Ruprecht, 1840:9. *pls. 8–9*; — Setchell & Gardner, 1925:624; — Smith, 1944:141. *pl. 24.*

Common throughout the range off rocky promontories. In beds arising from slightly greater depths than *Macrocystis*, and therefore usually along the outer edges of stands of *Macrocystis*, if both are present at the same place. Anomalous dwarf forms are rather frequently found in large tidepools.

POSTELSIA Ruprecht, 1852

Postelsia palmaeformis Ruprecht, 1852:19 (75). *pls. 6–8* (not seen); — Setchell & Gardner, 1925:625. *pl. 69*; — Smith, 1944:142. *pl. 25.*

Locally abundant between LHLW and MLLW throughout the range; on rocks exposed to heavy surf.

MACROCYSTIS C. Agardh, 1823

Macrocystis integrifolia Bory, 1826:10; — Setchell & Gardner, 1925: 628. *pl. 62*; — Smith, 1944:143. *pl. 26.*

On boulder fields between MLLW and LLLW and sometimes somewhat lower, at several stations on Cape Arago.

Macrocystis pyrifera (L.) C. Agardh, 1820:47; — Setchell & Gardner, 1925:627. *pls. 64–65*; — Smith, 1944:144. *pl. 31, figs. 3–4.*

Growing in sublittoral beds off most rocky promontories throughout the range.

LESSONIOPSIS Reinke, 1903

Lessoniopsis littoralis (Tilden) Reinke, 1903:25–28. *fig. 8*; — Setchell & Gardner, 1925:632. *pls. 67–68*; — Smith, 1944:145. *pl. 27*.

Lessonia littoralis Tilden, 1900, Amer. Algae, 342.

Locally abundant throughout the range between MLLW and LLLW levels on the most wave-exposed solid rock surfaces.

Tilden in her American Algae gave the first diagnosis of this species though the name was a long used, variously accredited, *nomenum nudum* at the time.

ALARIACEAE

ALARIA Greville, 1830

Alaria marginata Postels & Ruprecht, 1840:11; — Setchell, 1908:98; — Yendo, 1919:93. *pl. 6, figs. 1–4; pl. 19, fig. 4*; — Setchell & Gardner, 1925:640. *pl. 66*; — Smith, 1944:147. *pl. 28*.

Common throughout the range in places exposed to either rapidly flowing water or turbulent water between MLLW and LHLW.

Appearing with *Postelsia* there is very often a short form with small crowded sporophylls. While this is possibly the *Alaria nana* of Schrader (1903:162) there seems to be no qualitative and no non-intergrading quantitative difference between that and the present species. Some collections (*e.g.*, *MD 2455*, docks at Charleston, in July) are the same form as has been separated under the name *Alaria praelonga* but this too seems but a variation of *A. marginata* when all collections are considered. These specimens, from various harbor environments, are thinner in all parts, are lighter in color when dried, and have broader blades and sporophylls than those collected along the shores of the open ocean. The material from these latter stations (*e.g.*, *MD 4057* from Brookings, in December) compares well with Setchell & Gardner's illustration, which they call, "a plant medium in all of its characters . . .", with the exception that ours has longer sporophylls.

The material formerly (Sanborn and Doty, *ined.*) assigned to *A. valida* is now considered to be merely a form of *A. marginata*. Gardner also at one time considered this form with broad sporophylls to be *A. valida*, for it is so recorded in his notebooks among notes concerning his Oregon collections.

PTERYGOPHORA Ruprecht, 1852

Pterygophora californica Ruprecht, 1852:17 (73). *pl. 5*; — Setchell & Gardner, 1925:634. *pl. 74*; — Smith, 1944:148. *pl. 29*.

Growing intermingled with *Laminaria Andersonii* from LLLW levels downward. It is very probable that it grows in extensive sublittoral beds as reported by Smith for the Monterey area. Common throughout the range.

Occasionally this alga appears in tidepools where at first sight the various forms are not recognizable as this species. Macmillan (1902) gives good illustrations showing the intergradations between young *Alaria*-like forms and these peculiar tidepool forms.

EGREGIA Areschoug, 1876

Egregia Menziesii (Turner) Areschoug, 1884:3; — Setchell & Gardner, 1925:467; — Smith, 1944:149. *pl. 30, fig. 1.*

Common throughout the range. This alga along with *Hedophyllum* and *Alaria* is one of the most dependable and readily identifiable indicators of the MLLW and LHLW zone.

CYCLOSPOREAE

FUCALES

FUCACEAE

FUCUS Linnaeus, 1753

Fucus furcatus C. Agardh, 1820:97; — Gardner, 1922:16. *pl. 1, fig. 1; pls. 2–17*; — Setchell & Gardner, 1925:664; — Smith, 1944:152. *pl. 32, fig. 2.*

Abundant along the entire coast of Oregon. Gardner (1922) names a number of varieties of this species and two of them, var. *elongatus* and var. *angustus*, are specifically reported from the central coast of Oregon. This species is an indicator of the lower part of the LHLW to HHLW zone.

Gardner (1922:16, etc.) emphasizes the presence or absence of two kinds of structures, which he calls caecostomata and cryptostomata, in distinguishing between species of *Fucus*. *Cryptostomata* are conceptacle-like cavities lined or filled with sterile hairs and possessing an ostiole; *caecostomata* are conceptacle-like cavities without an ostiole and are more or less empty. While Gardner discusses the detailed structure he gives no means of distinguishing between the two without making sections. When herbarium specimens are viewed by transmitted light, the caecostomata, actually empty spherules, appear as minute dark rings in the thallus. By reflected light they appear as small smooth lumps on the surface of the thallus. By transmitted light cryptostomata, actually spherules more or less solidly filled with hairs, appear as dark spots in the thallus. By reflected light they may appear as small smooth bumps with an ostiole (often obscure) and usually with a tuft of projecting hairs. Near the base of the thallus of *Fucus furcatus* the caecostomata are crowded and approximately 0.2 mm. in diameter; in the upper part of the thallus they are larger (up to 0.4 mm. in diameter) and more scattered.

Fucus evanescens C. Agardh, 1820:92–93; — Gardner, 1922:36. *pl. 1, fig. 2; pls. 35–59*; — Setchell & Gardner, 1925: 681. *pls. 106–107.*

On wharves and rocks (from HHLW to 1 foot higher) within bays and tidal river mouths; common throughout Oregon at least as far south as Coos Bay.

When one examines all of the branches in a large clump of *Fucus* the various branches seem to fall into two or three of the varieties described by Gardner (1922). For this reason it has been impossible to identify with certainty many of the varieties he has described for this species. However his variety *stellatus* is quite distinct and has been found (*MD 2261*) on the old jetty in Coos Bay.

Fucus edentatus var. **hesperius** Gardner, 1922:28. *pl. 21*; — Setchell & Gardner, 1925:678. *pl. 103.*

Known only from the type (*Gardner 2653*) from "Sunset Beach," Cape Arago.

PELVETIA Decaisne and Thuret, 1845

Setchell & Gardner (1925:701) give Coos Bay, Oregon as the northernmost limit of the range of *Pelvetia fastigiata* (J. Ag.) DeToni. Although especially sought for by the author, *P. fastigiata* has not been found in the Coos Bay area or elsewhere along the Oregon coast. Neither are there any specimens from Oregon in the University of California herbarium, and the northernmost specimens in that herbarium are from Bolinas Bay in central California. Thus it is thought that Setchell & Gardner's record of this species from Oregon is based upon (a misdetermination of?) *Pelvetiopsis limitata* (Setchell) Gardner.

PELVETIOPSIS Gardner, 1910

Pelvetiopsis limitata (Setchell) Gardner, 1913:321. *pls. 38–41*; — Setchell & Gardner, 1925:703. *pl. 46, fig. 6*; — Smith, 1944:155. *pl. 33, fig. 1.*

Common in the upper part of the HHLW to LHLW zone with the variety *typica* ("forma" *typica* of Gardner) throughout the range and the variety *lata* ("forma" *lata* of Gardner) present at Cape Blanco and as far north as North Bay.

SARGASSACEAE

CYSTOSEIRA C. Agardh, 1820

Cystoseira osmundacea (Menzies) C. Agardh, 1820:69; — Gardner, 1913:333 ff. *pls. 51–53*; — Setchell & Gardner, 1925:709; — Smith, 1944:156. *pl. 34.*

Collected throughout the range at least as far north as the Nehalem River; from MLLW down to LLLW and in places on down to the −10.0 foot level.

Oregon material may all be referred to the variety *typica* (forma *typica*) of Gardner.

(To be continued)

EXPLANATION OF PLATE 1

All figures are drawn with the aid of a camera lucida. The name and number in parentheses after the specific name identifies the material from which the drawing was made. The magnification is indicated at the end of each figure description.

Fig. 1–3. *Enteromorpha angusta* (*Gardner 4430*, **isotype**).
1. Edge of blade from upper portion of frond. × 244.
2. Center of blade in the apical region. × 244.
3. Cross section of upper portion of stipe margin. × 244.

Fig. 4–6. *Enteromorpha angusta* (*MD 6058*, **topotype**).
4. Cross section 0.5 cm. above base. × 260.
5. Surface view of cells. × 260.
6. Cross section of blade margin. × 260.

Fig. 7–9. *Enteromorpha linza*. Cross sections of center and margin of typical *E. linza* blades. × 282.

Fig. 10–11. *Enteromorpha linza* var. *oblanceolata* (*O'Neal 433*, **type**).
10. Center of upper part of blade. × 285.
11. Stipe margin. × 285.

Fig. 12–14. *Enteromorpha vexata* (*W. Wells 38*).
12–13. Cells in surface view; cross section through margin. × 250.
14. Cross section of stipe. × 67.

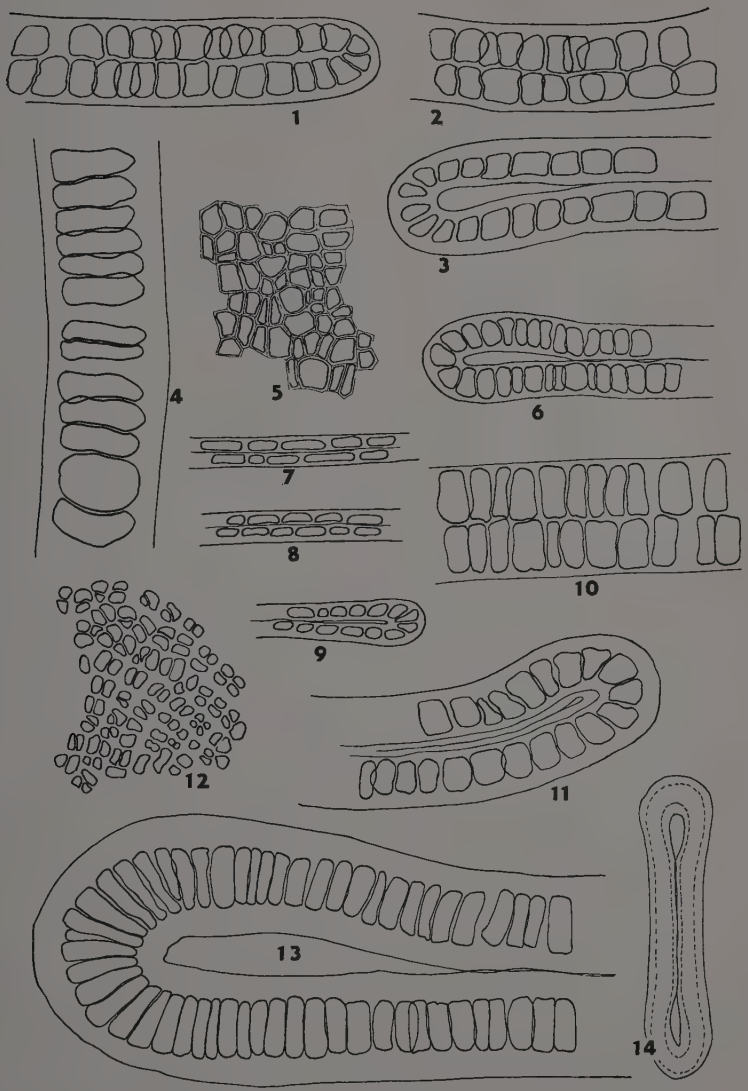

PLATE 1

EXPLANATION OF PLATE 2

All figures are drawn with the aid of a camera lucida. The name and number in parentheses after the specific name identifies the material from which the drawing was made. The magnification is indicated at the end of each figure description.

Fig. 1–2. *Ulva stenophylla* (*MD 6126*).
1. Blade margin from the upper portion of a mature frond. × 256.
2. A portion of the center of the same thallus. × 256.

Fig. 3. *Ulva fenestrata* (*MD 2690*). Cross section through central portion of blade. × 300.

Fig. 4–5. *Monostroma zostericola* (*O'Neal 227*).
4. Cells in surface view. × 465.
5. Cross section through center of thallus. × 465.

Fig. 6–10. *Ulva californica* (*Univ. Calif. Herb. 77933*).
6–7. Cross section of thallus margin. × 210.
8. Cross section through center of blade. × 256.
9. Cross section through stipe. × 62.
10. Cross section through margin of thallus near base. × 256.

Fig. 11–12. *Ulva taeniata* (*O'Neal 435*).
11. Cross section through blade center. × 232.
12. Cross section of central portion of the base. × 232.

Fig. 13–14. *Monostroma oxyspermum* (*MD 6136b*).
13. Cross section of edge of blade. × 336.
14. Surface of central portion of thallus. × 336.

Fig. 15. *Monostroma oxyspermum* (*MD 4924*). Cross section of thallus. × 550.

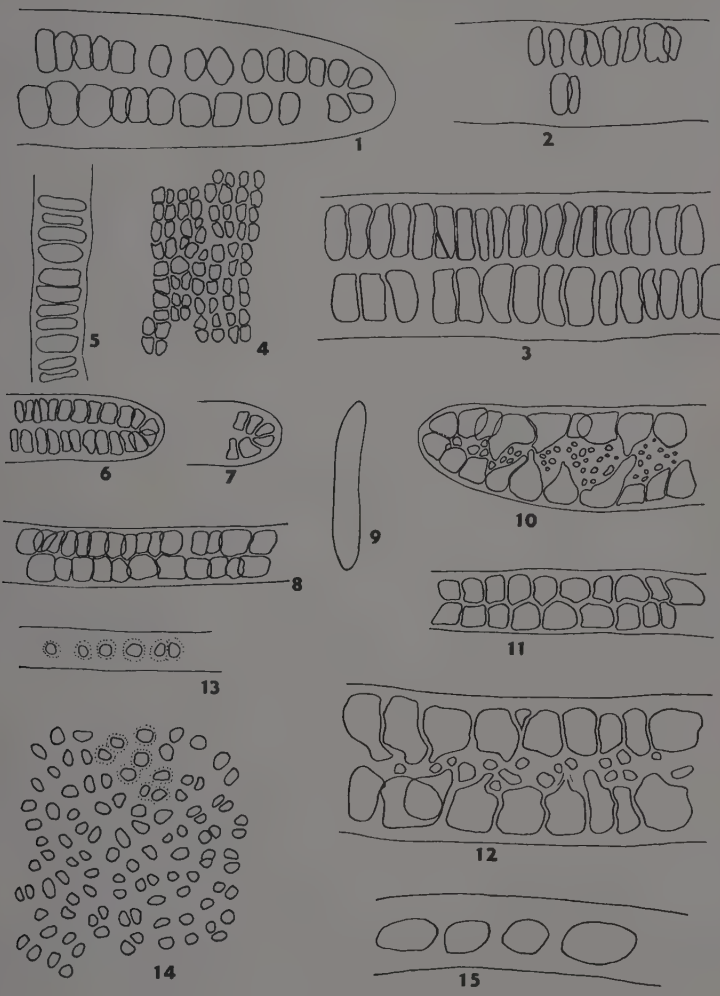

PLATE 2

EXPLANATION OF PLATE 3

All figures are drawn with the aid of a camera lucida. The name and number in parentheses after the specific name identifies the material from which the drawing was made. The magnification is indicated at the end of each figure description.

Fig. 1–2. *Enteromorpha minima* (*MD 6211*).
1. Cross section of thallus. × 385.
2. Cell arrangement on the surface. × 385.

Fig. 3–4. *Enteromorpha minima* (*MD 5992*). Similar cross section and surface arrangement of the cells. × 440 and × 385 respectively.

Fig. 5–7. *Cladophora delicatula* (*Gardner 2747*). Drawings to show the trichotomies peculiar to this species. × 1800.

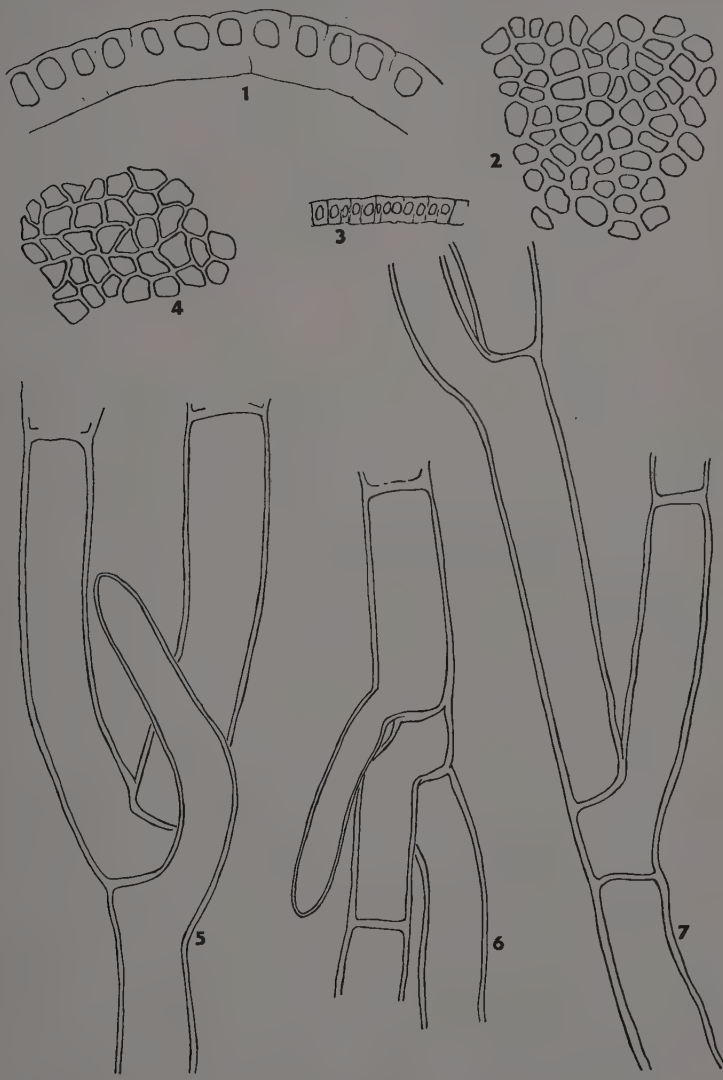

PLATE 3

EXPLANATION OF PLATE 4

All figures are drawn with the aid of a camera lucida. The name and number in parentheses after the specific name identifies the material from which the drawing was made. The magnification is indicated at the end of each figure description.

Fig. 1. *Cladophora hemispherica* (*Gardner 4620*). Showing the branching and shape of the basal cells of the branches. × 232.

Fig. 2. *Cladophora delicatula* (*Gardner 2747*). Showing in particular the development of the characteristic trichotomies. × 730.

Fig. 3–4. *Ulva taeniata* (*C. L. Doty 1998*). Cross section of thallus margin and view of surface arrangement of cells near margin. × 320.

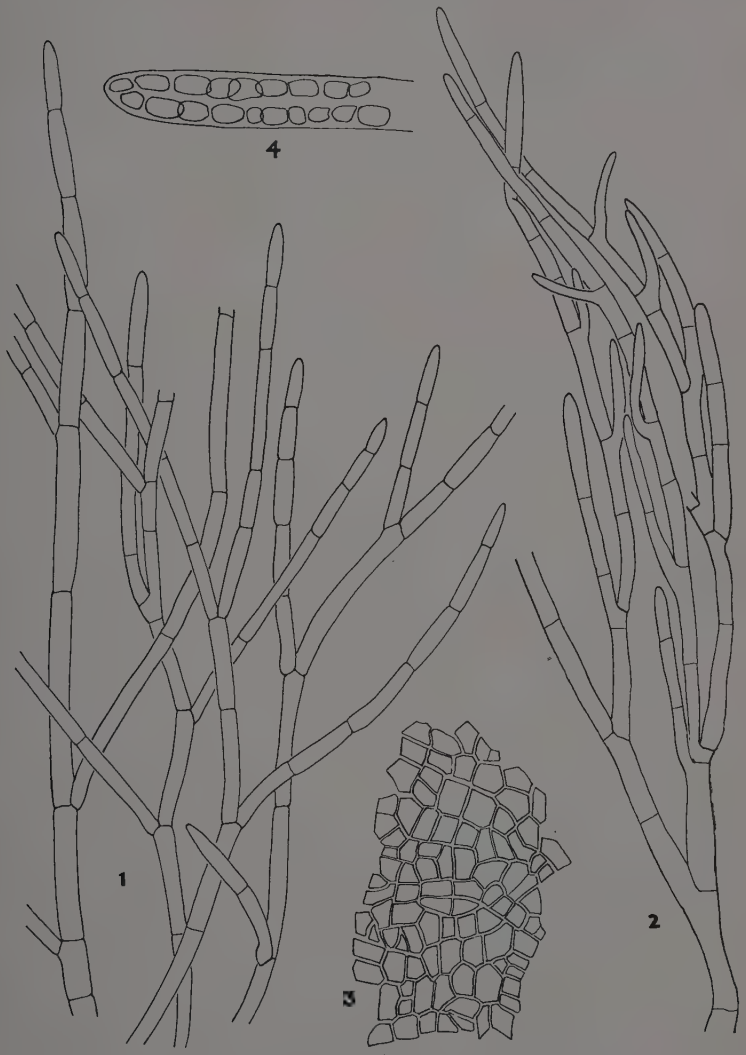

PLATE 4

EXPLANATION OF PLATE 5

All figures are drawn with the aid of a camera lucida. The name and number in parentheses after the specific name identifies the material from which the drawing was made. The magnification is indicated at the end of each figure description.

Fig. 1. *Spongomorpha spinescens* (*MD 4550*). Illustrating the simple hooked branches, spiny branches, and blunt tips. × 520.

Fig. 2–4. *Hormidium rivulare* (*MD 4716*). Illustrating some of the larger rhizoids and the Stichococcus-like cells associated with them. × 730.

Fig. 5. *Spongomorpha spinescens* (*MD 4550*). Rhizoidal branchlet. × 520.

Fig. 6. *Spongomorpha spinescens*. Habit sketch. Reduced × 3/5.

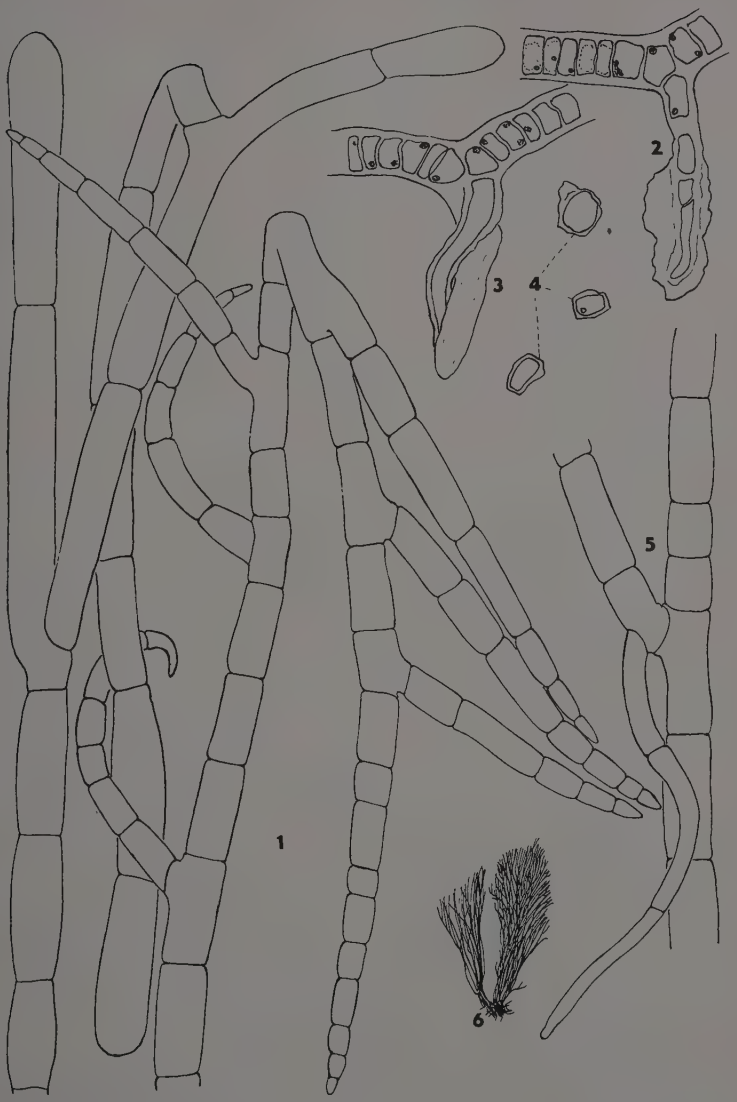

PLATE 5

EXPLANATION OF PLATE 6

All figures are drawn with the aid of a camera lucida. The name and number in parentheses after the specific name identifies the material from which the drawing was made. The magnification is indicated at the end of each figure description.

Fig. 1–9. *Hormidium rivulare* (*MD 4716*). Illustrating the origin of rhizoids. × 230.

Fig. 10–12. *Spongomorpha Mertensii* (*Gardner 4446*). Illustrating the compound hooked branchlets, some of which are rhizoidal in nature. × 740.

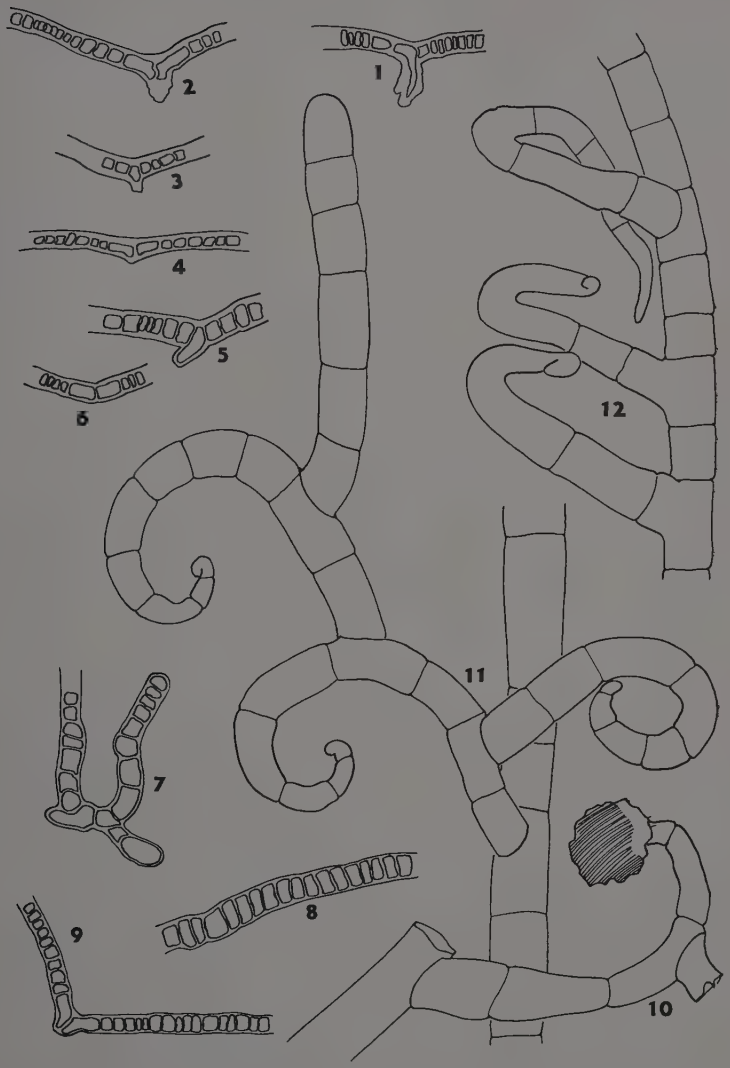

PLATE 6

EXPLANATION OF PLATE 7

All figures are drawn with the aid of a camera lucida. The name and number in parentheses after the specific name identifies the material from which the drawing was made. The magnification is indicated at the end of each figure description.

Fig. 1–2. *Urospora grandis* (*MD 2230*). × 270.

Fig. 3, 5–8. *Urospora doliifera* (*MD 6134*). × 710.

Fig. 4. *Urospora penicilliformis* (*MD 4129*). × 320.

Fig. 9. *Urospora Wormskjoldii* (*MD 2006*). × 51.

PLATE 7

EXPLANATION OF PLATE 8

The name and number in parentheses after the specific name identifies the material from which the photographs were made. The magnification is indicated at the end of each figure description.

Fig. A. *Ectocarpus Haplogloiae* (*MD 2491*, **isotype**). × 0.5.

Fig. B. *Ulva linza* var. *oblanceolata* (*O'Neal 433*, **cotype**). × 0.27.

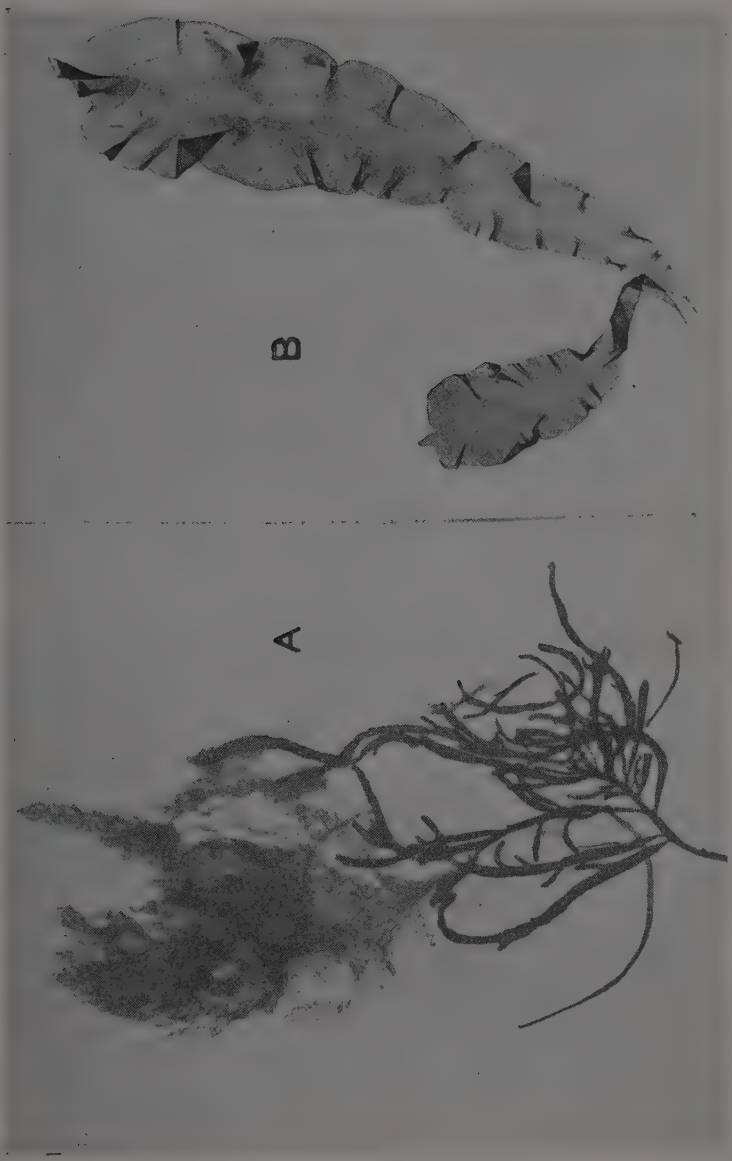

PLATE 8

EXPLANATION OF PLATE 9

The name and number in parentheses after the specific name identifies the material from which the photographs were made. The magnification is indicated at the end of each figure description.

Fig. A. *Scytosiphon attenuatus* (*MD 2544*). × 0.25.

Fig. B. *Scytosiphon complanatus* (*O'Neal 422a*). × 0.19.

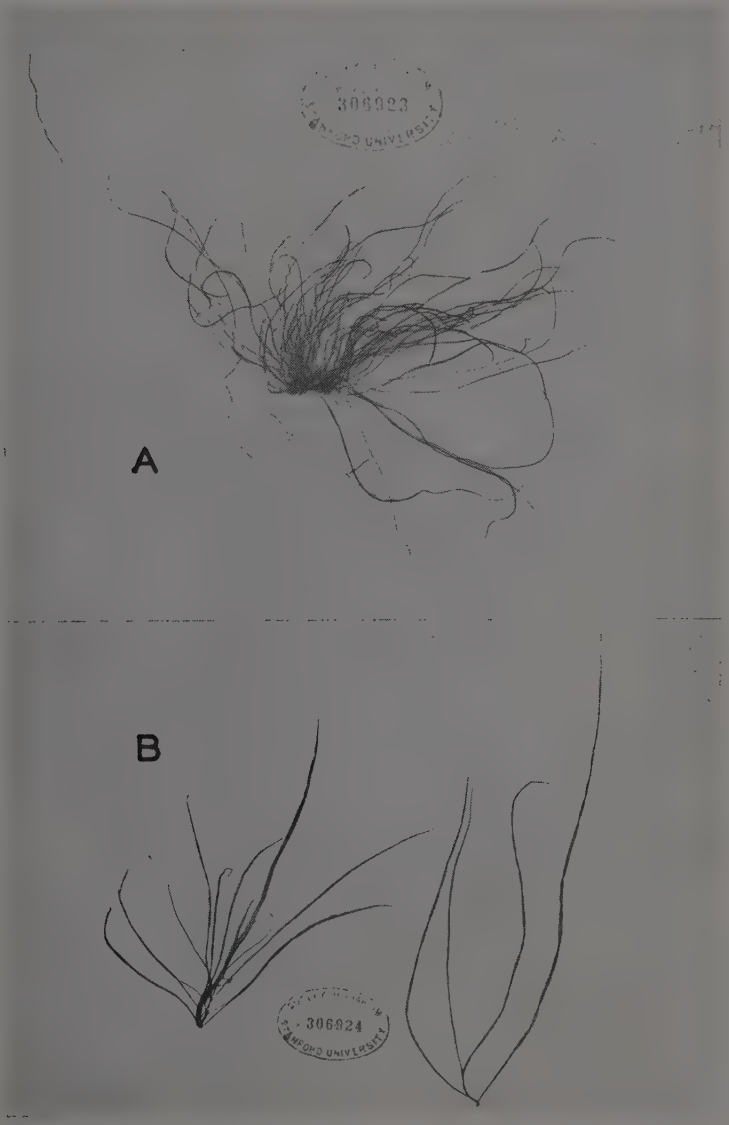

PLATE 9

EXPLANATION OF PLATE 10

The name and number in parentheses after the specific name identifies the material from which the photograph was made. The magnification is indicated at the end of the figure description.

Laminaria ephemera (*C. L. Doty 1949*). × 0.16.

PLATE 10

3(1):67–71 FARLOWIA JANUARY, 1947

A NOTE ON A CHARA NEW TO THE PHILIPPINE ISLANDS

ROY M. WHELDEN

Among the undetermined species of *Chara* in the Farlow Herbarium collection was one which was sharply distinct from all the others in its complete lack of either cortication or incrustation. Brief examination showed the plant to be dioecious and to have a stipular crown formed of a single row of cells. Very few Charas having this combination of characters have been described, making rather easy the problem of identification of the species.

The only two species thus limited that have been described are *Chara australis* R. Brown (with a subspecies *plebeja* (R. Brown) A. Braun) and *Chara Wallichi*, these two differing in the nature of the bracts of the leaf nodes, those of *Chara australis* being very short or even practically lacking while the leaf bracts of *Chara Wallichi* are as long as the sporangia. The sporangia are also distinct in the two species, those of *Chara australis* having low rounded ridges, those of *Chara Wallichi* having the ridge very prominent.

Robert Brown's original very brief description (1810) of *Chara australis* was based on a plant from Australia: the plant was ecorticate, with the lower whorls of leaves far apart, leaves articulate; dioecious. Alexander Braun mentioned this species in many of his papers on Characeae (1840, 1852, among others); he described it in a footnote on p. 148 in Plantae Preissianae (1846). Here he stated that the plant was completely ecorticate, pliant, with the lower leaf whorls remote, the upper close together; composed of rather thick leaves of three nearly equal segments, the last tipped with a minute mucro; both at the base and at the joints of the leaves bracts are almost lacking; the large antheridia are grouped at the joints; dioecious; sporangia unknown. Both Kützing (1849) and Wallman (1853) give practically the same description. In Tab. Phycol. (1857) Kützing figures, not very satisfactorily, some branches at natural size (as *Nitella australis*).

In 1883 Nordstedt prepared Braun's manuscripts for final publication and presented all the information contained therein on this species. In these he presented three varieties of *Chara australis*, namely var. *nobilis*, var. *lucida*, var. *Viellardi*. The sporangia of var. *lucida* are described as having very broad spiral ridges which are very hard to see. In this variety the leaf bracts are described as distinctly visible; otherwise the three varieties are described much as in earlier descriptions, but with dimensions given. The species is known to have been found in Australia, Tasmania, New Zealand and New Caledonia.

The occurrence of a similar *Chara* in the Philippine Islands is of some interest. The specimen, collected at a fountain near San Juan, Rizal, in May 1940 by G. T. Velasquez, shows a tangled mat about 7 cm. across,

formed of parts of several plants, so intricately mingled as to make disentanglement extremely difficult. Several small branch tips were removed and mounted. Some of these branches bear mature sporangia, others have antheridia in various stages of development, while the greater number are quite sterile. It is entirely ecorticate and has no sign of incrustation even on the sporangia, and appears quite glossy and brownish-yellow in the dried condition. The stem segments are straight, cylindrical, up to 3 cm. in length and 860 μ in diameter (Fig. 1). The leaves are borne 6–9 in a whorl, each leaf being formed of 2–4 cylindrical segments and constricted slightly at the joints. (Fig. 2 a, b.) In most cases the ultimate leaf segments are tipped by 1–3 conical cells, the longest measuring 170 μ in length. (Fig. 7 a, b, c, d.)

The stipular crown contains but a single row of cells, usually of the same number as the leaves in the whorl and alternating with their bases, (Fig. 3 b, c) but sometimes being twice the number of the leaves, a pair of stipules then occurring between adjoining leaf bases. (Fig. 3a.) The stipules are upward directed elongate conical cells 160–220 μ long. The sporangia and antheridia are borne on the lower 1–3 nodes of the leaves, (Fig. 2 a, b.) and also frequently occur at the base of the leaf, in which instance the sporangia form a beautifully symmetrical ring about the stem. The sporangia usually occur singly at each node, the antheridia more frequently are paired. Single antheridia occur usually only at the distal fruiting node. The mature sporangia are 710–820 μ long and 690 μ in diameter and have 6–7 spiral cells (Fig. 4). The oöspore is very firm, black and 585 μ long and 490 μ in diameter and shows 6 very low rounded spiral ridges. (Fig. 5) The mature antheridia are up to 720 μ in diameter (Fig. 6), though usually under 650 μ, and orange-colored.

The leaf bracts, always present at every node, show some variation in number and size, but are always rather small and inconspicuous. In sterile leaves the number is from three to five bracts of unequal size at each node, the longest being on the inner side of the leaf. In antheridia-bearing leaves the bracts are usually 2 or 3 of approximately equal size. (Fig. 6) They occur on the opposite side of the leaf from the antheridia. Frequently there are, in addition to the bracts, 2–3 minute spherical cells present at the same node. In sporangia-bearing leaves the bracts show greater variation in number and size; usually there are 5–7 bracts uniformly arranged about the node, the longest subtending the sporangium. Occasionally all bracts at a single sporangium-bearing node are about equal in length. The length varies from 300–480 μ but never exceeds one-third of the length of the sporangium.

The Philippine plant described above is *Chara australis* R. Brown, differing in no material point from any of the early descriptions of this species. A close examination of the specimen shows that in many ways it is a very variable plant. The same fact is indicated by the recorded though minor differences in the several early descriptions. Because of this variability it does not seem wise to set off the Philippine plant as a

variety. Its occurrence in the Philippine Islands extends greatly the known range of *Chara australis* R. Brown.

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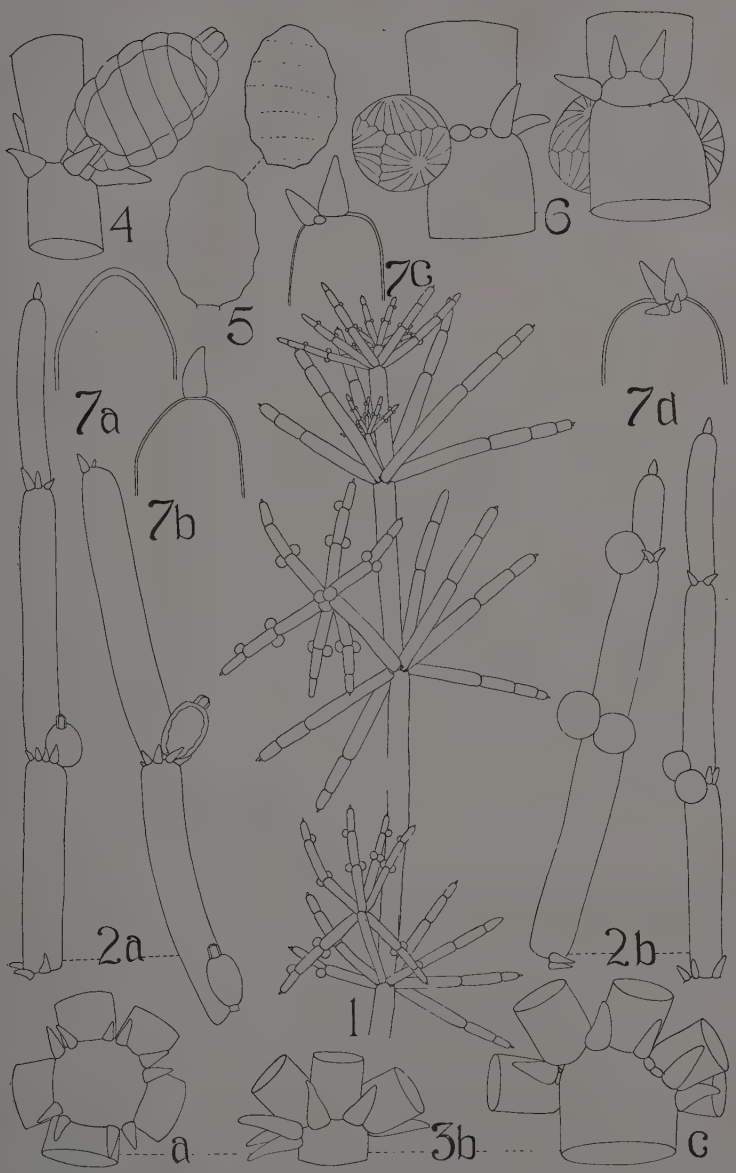
EXPLANATION OF PLATE

All figures were drawn with the aid of a camera lucida.

Fig. 1. Tip of branch of male plant.
Fig. 2a. Sporangia-bearing leaves, showing bracts.
Fig. 2b. Antheridia-bearing leaves, showing bracts.
Fig. 3a. Stipular crown with two stipules at base of each leaf.
Fig. 3b–c. Stipular crown with single stipules alternating with leaf bases.
Fig. 4. Sporangia, showing bracts.
Fig. 5. Oöspores.
Fig. 6. Antheridia, showing bracts.
Fig. 7a–d. Leaf tips, showing variation of apical mucro.


4
5
6
7c
7a
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7d
2a
2b
1
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3b
c

3(1):73–93 FARLOWIA JANUARY, 1947

CRITICAL OBSERVATIONS ON THE USTILAGINACEAE

ELISA HIRSCHHORN [1]

There has been a strong tendency for many years for mycologists and phytopathologists to place too much emphasis on slight morphologic variations and on host specialization as criteria for the identification of parasitic species of fungi. This has given rise to the description of many species which do not even represent different physiologic forms, to say nothing of different varieties or species. The taxonomic literature is replete with species based upon slight biometric differences or on their physiological specialization to a single genus or species of host plant. A parallel case is furnished by the treatment of the smuts which grow on species of *Polygonum* and to a certain extent, those on *Carex* spp. and *Rhynchospora* spp. Such criteria, however, must now be revalued since it is known that the fungus species are made up of physiologic forms which differ only in their capacity to attack certain host plants and not others. Furthermore there is some evidence that the environment has a great deal to do with the variation of morphologic and physiologic characteristics of pathogenic fungi.

In the present paper the writer furnishes evidence of the morphologic similarity of some species of *Ustilago* and *Cintractia* which had formerly been considered, on the grounds mentioned above, to be distinct. These studies have been based for the most part on type or authentic specimens.

SPECIES OF USTILAGO ON GRAMINEAE

1. **Ustilago hypodytes** (Schlechtendal) Fries, Syst. Mycol. **3:** 518. 1829.

PLATE I, FIG. E

Sori surrounding the internodes, sometimes extending into the abortive inflorescence, naked. Chlamydospores olivaceous, brown, globose or subglobose, 4–7 μ diam.; epispore smooth.

HOSTS: *Elymus arenarius* L. and *Elymus* sp.

SPECIMENS EXAMINED: **Germany:** Borussia, near Berlin, on *Elymus arenarius*, Oct. 1884, *P. Sydow in* Rabenhorst: Fungi Europ. Ser. 2, No. 3201 (FH). — Grunewald, Berlin, Aug. 1884, *P. Sydow in* P. Sydow: Mycotheca Marchica, No. 5222 (FH). — **England:** Broughty Fenn, on *Elymus* sp., *Sadler in* Cook: Fungi Britannici Exsic. No. 33 (FH). (In this specimen there are a very few chlamydospores, approximately one in one thousand, which have slight bipolar crests.)

Fischer and Hirschhorn (3) have furnished evidence that the great majority of the collections of the stem smuts on grasses from all over the

[1] This work was done as a Guggenheim Fellow at the Farlow Herbarium, Harvard University. The writer wishes to express her deep appreciation to Dr. David H. Linder for his kindness in providing access to the herbarium, for his photographic assistance, and for correction of the manuscript.

world which have been considered to be *Ustilago hypodytes* are in reality *U. Spegazzinii* Hirschhorn, *U. Spegazzinii* var. *agrestis* Fischer & Hirschhorn, *U. Williamsii* Griffith and *U. halophyla* Speg. These authors, after examination of hundreds of specimens, including a topotype of the so-called *U. hypodytes*, proved that the species is not so widely distributed as it was formerly thought, and that the species which was considered to be *U. hypodytes* was in reality a species complex. The impossibility of obtaining the type specimen and the lack of a complete original diagnosis led to the conclusion that *U. hypodytes* is a *nomen dubium* or *nomen ambiguum*.

According to several mycologists, *U. hypodytes* possesses smooth chlamydospores, but careful observations have demonstrated that almost all the specimens studied have chlamydospores that are slightly pitted and provided with bipolar hyaline or concolorous crests which are characteristic of *U. Spegazzinii* or its variety *agrestis*. Neither Schlechtendal nor Fries makes reference to the bipolar crests in their original descriptions, the only helpful reference being that the species is based on a specimen collected near Berlin on *Elymus arenarius*.

Recent examination of the immensely rich collections at the Farlow Herbarium, Harvard University, permitted the writer to extend her observations on numerous additional collections of stem smut on grasses, among which was one from Berlin on *Elymus arenarius*. This specimen agrees with the original description in that it possesses smooth chlamydospores that are devoid of pitting, or lack the bipolar crests, and hence agree perfectly with the original description. Since the name *Ustilago hypodytes*, because of the recent gains in knowledge concerning the species of stem smuts on grasses, becomes a *nomen dubium*, it is desirable to clarify the species and to select a lectotype. It is therefore proposed that the specimen on *Elymus arenarius* (the type host) and collected by P. Sydow near Berlin in October, 1884 be chosen as the lectotype. Such a choice has the advantage that the species was widely distributed in Rabenhorst's Fungi Europea, Ser. 2 as number 3201.

Ustilago nummularia Spegazzini (7) on *Stipa speciosa* possesses characters that are very similar to those of *U. hypodytes*, differing only in that some of the chlamydospores are slightly papillose. For this reason, *U. nummularia* should perhaps be considered a synonym of *U. hypodytes* or at most a variety of that species.

2. **Ustilago minima** Arthur, Bull. Iowa Agr. Coll. 1884:172. 1885.
Ustilago Stipae Ciferri, Ann. Mycol. **29:** 52. 1931.

Sori surrounding the internodes or occasionally the aborting inflorescence, covered by a whitish fungous membrane. Chlamydospores brown to light brown, 3–5 μ diam.; epispore smooth.

HOST: *Stipa spartea* Trin.

As was reported by Fischer and Hirschhorn (3), one of the specimens used for the description of *U. Stipae* Ciferri, on *Stipa spartea*, did not

agree with the characters in the original description because the chlamydospores possess the bipolar crest that is typical of *U. Spegazzinii*. Studies of the other specimens (Seymour & Earle: Econ. Fungi, No. C70 and U. S. Bureau of Plant Industry, Mycological Exchange of 1921, on *Stipa spartea*, Ames, Iowa, 9 July 1892, *F. C. Stewart*) which were used by Ciferri for his description, agree with the characters mentioned in the original diagnosis by Ciferri. The specimen in Seymour & Earle: Econ. Fungi No. C70, although not so designated, should therefore be considered the type of *U. Stipae*. It appears, however, that Ciferri overlooked the fact that in his specimen the fungus produces a sorus which is covered by a fungous membrane. This character, plus the smooth, brown chlamydospores which measure 3–5 μ in diameter, make it evident that *U. Stipae* is identical with *U. minima* Arthur, also described on *Stipa spartea*. For this reason *U. Stipae* must be considered a synonym of *U. minima*, which has priority.

3. **Ustilago Zeae** (Keckmann) Unger, Einfl. d. Bodens. p. 211. 1836.
Ustilago Euchlaenae Passerini *in* Anzi, M. *et al.* Erb. Critt. Ital. Ser. II, fasc. 23/24, No. 1125. 1882.

PLATE I, FIGS. C-D; PLATE III

Sori in different parts of the host forming galls covered by a whitish host membrane; chlamydosporic mass olive-brown to brown-black. Chlamydospores brownish olivaceous to brownish yellow, globose or subglobose, 5–20 μ diam.; epispore echinulate.

HOSTS: *Zea Mays* L. and *Euchlaena mexicana* Schrad.

SPECIMENS EXAMINED: **Germany:** *in* F. Petrak: Flora Bohem. Morav. Exsic. No. 902 (FH).—**Italy:** on *Euchlaena luxurians* (= *E. mexicana*), *Arcangeli*, 1880, *in* M. Anzi *et al.*: Erb. Critt. Ital. Ser. II, No. 1152 (FH).—**United States: Illinois:** Urbana, on *Euchlaena mexicana*, Sept. 1897, *G. P. Clinton* (FH).—**Iowa:** Ames, on *Euchlaena luxurians*, 20 Sept. 1898, *A. F. Sample* (FH).—**New York:** Ithaca, Randolf's Breeding Plots, on *Euchlaena mexicana*, *L. F. Randolf* (FH, CU–P, 19546).—**Indiana:** Cambridge City, on *Zea Mays*, 1901, *W. R. Littell* (BPI, FH).—**Uruguay:** Distr. Colonia, Estanzuela, on *Z. Mays*, 1931, *Mrs. Berger in* Herter: Plantae Uruguay. Exsic. No. 1453 (FH).—**Philippine Isds.:** Cebu, Compostella, on *Z. Mays*, Apr. 1927, *A. Derecho* (PHILIPP. NAT. HERB., 1605, FH).—**Japan:** Sapporo, on *Z. Mays*, Oct. 1889, *K. Miyabe* (FH).—**China:** Kwangsi Prov., Ling Yuin Hsien, on *Z. Mays*, 2 June 1933, *S. Y. Cheo, 2236* (FH).—Kweichow Prov., Tsunyi Hsien, on *Z. Mays*, 27 July 1931, *S. Y. Cheo, 130* (FH).

Ustilago Zeae is one of the most common parasites of *Zea Mays* and is reported frequently on *Euchlaena mexicana*. In 1882, Passerini published a descriptive note as part of the label of specimens collected by Arcangeli and issued in Anzi's *et al.* Erb. Critt. Ital. as number 1152, a point that is sometimes overlooked and has resulted in the accrediting of the species to Arcangeli. The original description is as follows: *Differt a communi Ustilagine Maydis Tul., statione sporisque vix majoribus (0.010 mik.). . . . Sporae globosae, pallide aurantio-fuscae, episporio leviter papillato, 8–10 mk. diam.* A study of the type specimen of *U. Euchlaenae* makes clear the morphologic identity of *U. Euchlaenae* and *U. Zeae*. Both form

galls which enclose a dusty, olivaceous brown chlamydosporic mass. The chlamydospores of both are olivaceous brown to olivaceous yellow, 5–11 μ in diameter, with echinulate epispore. Passerini mentioned that his species differs from *U. Zeae* because it possesses larger chlamydospores. Probably he had not observed much material of *U. Zeae* since there are cases when chlamydospores of this species reach 20 μ in diameter. The only slight difference between the two species is that *U. Euchlaenae* produces paler chlamydospores, a difference which in itself does not justify recognizing the two species as distinct, even varietally. Therefore *U. Euchlaenae*, which is a later name, should fall into synonymy and *U. Zeae* should be retained as the valid name.

Ustilago Kellermanii Clint. was included by Ciferri (1) as a synonym of *U. Euchlaenae*. Although type material of *U. Kellermanii* was not available to the writer, she was able to study material of this species, made available through the kindness of Mr. John A. Stevenson, and found that it agreed in all details with the original diagnosis. The characters were found to be sufficiently distinct to warrant the maintenance of *U. Kellermanii* as a distinct species: it does not form galls (Plate IV) and the chlamydospores are darker and have more pronounced echinulations. Although the maintenance of the species as distinct is tentatively accepted, there is undoubtedly a need for experimental studies with cross inoculations before a final disposition should be made.

SPECIES OF USTILAGO ON POLYGONUM AND RUMEX

Among the species of smuts that occur on *Polygonum* and *Rumex* spp., the author has found that *U. anomala*, *U. Parlatorei*, and *U. Bistortarum* have an unexpected degree of synonymy which, on the basis of preliminary studies, are indicated below.

1. **Ustilago anomala** Kunze, Fungi Exsiccati No. 23. 1875.
   Ustilago persicariae Ciferri, Ann. Mycol. **29**: 41. 1931.
   Ustilago muricata Liro, Ann. Acad. Sci. Fenn. Ser. **A17**: 238. 1924.

PLATE I, FIGS. F–J; TEXT FIG. I, A–C

Sori in the inflorescence. Chlamydospores yellow-hyaline to slightly brown or violet, globose to ovoid, 7–12 μ diam.; epispore reticulate, the reticulations polygonal and up to 2.6 μ diam.

HOSTS: *Polygonum dumetorum* L., *P. Persicaria* L., *P. Hydropiper* L. and *P. Convolvulus* L.

SPECIMENS EXAMINED: **Germany**: Saxony, on *Polygonum dumetorum*, August 1875, *J. Kunze in* Kunze: Fungi Sel. Exsic. No. 23, **type** of *U. anomala* (FH). — Rheinprovinz, Petersberg near Trier, on *P. Convolvulus*, 12 Oct. 1925, *C. Fahrendorff in* Zillig: Ustilag. Europ. No. 52a (FH). — Brandenburg Grossmantel, Aug. 1924, *C. Fahrendorff in* Zillig: Ustilag. Europ. No. 52b (FH). — Mellensee, Kr. Teltow, 20 July 1925, *C. Fahrendorff in* Zillig: Ustilag. Europ. No. 52c (FH). — Berlin, Silmargendorf, on *P. Convolvulus*, 2 Sept. 1891, *P. Hennings in* Sydow: Ustilagineen No. 1 (FH). —

Silmargendorf, on *P. Convolvulus*, Aug. 1886, *P. Sydow in* Sydow: Mycotheca Marchica No. 4112 (FH). — Bavaria. Stopfelfelder, Höhberger Wald near Würzburg, 11 Sept. 1924, *H. Zillig in* Zillig: Ustilag. Europ. No. 66, **type** of *U. persicariae* (FH). — Nanhof near Ludkenwalde, on *P. Persicaria*, Aug. 1896, *P. Sydow in* Sydow: Ustilagineen No. 119 (FH). — **France**: Lorraine, Kelschberg near Forbach, on *P. Convolvulus* 13 Aug. 1913 and 5 Oct. 1900, *A. Ludwig in* Sydow: Mycotheca German. No. 1222 (FH). — **Czechoslovakia**: Moravia near Adamsthal, on *P. Convolvulus*, September, *G. v. Nitschke in* Rabenhorst-Winter: Fungi Europ. No. 3101 (FH). — Bohemia, Tabor near Luznice River, on *P. dumetorum*, 7 Oct. 1905, *Fr. Bubák in* Sydow: Ustilagineen No. 376 (FH). — **Hungary**: Nagybaracska, on *P. Hydropiper*, 25 Sept. 1925, *F. Greinich in* Zillig: Ustilag. Europ. No. 94 as *U. Cordai* Liro (FH). — Komitat Bacs, on *P. mite*, 21 Sept. 1905, *F. Greinich in* Zillig: Ustilag. Europ. No. 68 as *U. muricata* Liro (FH). — **Poland**: Warsaw, Bielany, on *P. dumetorum*, *Kochman in* Kochman: Ustilag. Polonia No. 16 (FH). — Krukienice Distr., Mrotschka, on *P. Convolvulus*, 3 Sept. 1937 *in* Kochman: Ustilag. Polonia No. 17 (FH). — **Sweden**: Stockholm, on *P. Convolvulus*, Aug. 1884, *J. Eriksson in* Eriksson: Fungi Parasit. Scandinav. Exsic. No. 155 (FH). — **United States**: **Connecticut**, Montowese, on *P. dumetorum*, 14 Sept. 1903, *G. P. Clinton in* Seymour & Earle: Econ. Fungi Supplem. C, No. C134.

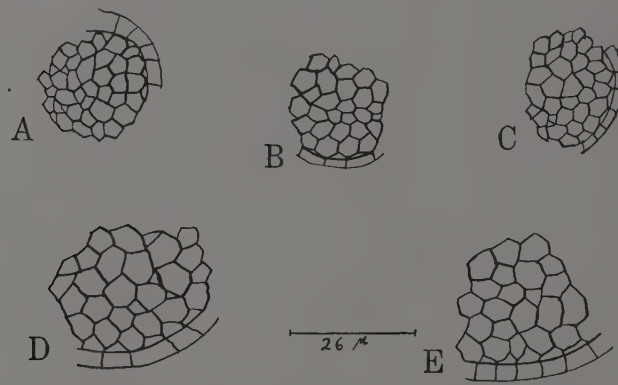
Ustilago anomala Kunze, *U. persicariae* Ciferri, *U. muricata* Liro, *U. carnea* Liro, and *U. Cordai* Liro attack *Polygonum dumetorum*, *P. Persicaria*, *P. mite* and *P. Hydropiper* respectively, and all of these fungi form their chlamydospores in the ovaries, the chlamydospores all possessing reticulate epispores. The descriptions of the species were based almost entirely on slight variations in color, diameter, reticulation of the epispore, and host specialization. A careful study of type or authentic material of these species demonstrates that there is a very great similarity between the species, especially between *U. anomala*, *U. persicariae* and *U. muricata*, as is shown in Table I.

TABLE I. CHLAMYDOSPORE CHARACTERS OF *U. ANOMALA*, *U. PERSICARIAE*, *U. MURICATA*, *U. CARNEA*, AND *U. CORDAI*

SPECIES	COLOR	FORM	DIAMETER	EPISPORE
U. anomala	yellow-hyaline, slightly darker at epispore	globose-ovoid	7–13 μ	deeply reticulate: reticulation 1.9–2.6 μ 0.6–1 μ deep.
U. persicariae	as above	as above	9–12 μ	as above
U. muricata	yellow-hyaline, few pale violet	as above	7–12 μ	as above
U. carnea	hyaline	as above	7–12 μ	deeply reticulate, reticulations 4–6 μ in diameter
U. Cordai	yellowish to pale brown	as above	7–12 μ	as above

Comparing the characters given in Table I, it appears that the five species are very closely related and that the differences between the first three species consist only in a slight variation in color and size (1–2 μ) of

the chlamydospores. Considering that these three species grew on different host species, it is absurd to designate them as different species or even as different morphological varieties. Since host specialization does not affect their morphology, it is proposed to make *U. persicariae* and *U. muricata* synonymous with *U. anomala*. The second group of species, *U. carnea* and *U. Cordai*, as shown in Table I form a group that is characterized by the markedly larger size of the reticulations of the epispore. As a rule, the color of the chlamydospores of *U. Cordai* is darker than that of *U. anomala*, whereas those of *U. carnea* are the same color or else some-



TEXT FIG. I. Camera lucida drawings to show the reticulations characteristic of **A.** *Ustilago anomala*, from type material. **B.** *Ustilago persicariae*, from type material. **C.** *Ustilago muricata*, from type material. **D.** *Ustilago carnea*, from type material. **E.** *Ustilago carnea*, from authentic material.

what lighter. The color of the chlamydospores is a character that varies considerably with environmental conditions and is somewhat dependent upon host relations. In view of the fact that the size of the reticulations is the only consistent character that can be used to segregate the species *U. carnea* and *U. Cordai* from the remainder of the complex, it seems desirable to recognize *U. carnea* as a variety of *U. anomala* and to make *U. Cordai* a synonym of this variety. The new combination is proposed below.

Ustilago anomala var. **carnea** (Liro) Hirschhorn n. comb.

Ustilago carnea Liro, Ann. Soc. Zool. Bot. Fenn. Vanamo **1**: 27. 1923.
Ustilago Cordai Liro, Ann. Acad. Sci. Fenn. Ser. A **17**: 12. 1924.

TEXT FIG. I, D–E

Sori in the inflorescences. Chlamydospores deep yellow to brown, 7–12 μ diam., globose or ovoid; epispore deeply reticulate, the reticulations 5–6 μ in diameter.

HOSTS: *Polygonum Convolvulus* L. and *P. Hydropiper* L.

Liro differentiated these species on the basis of their host specialization, but if such a criterion were to be followed consistently for all parasitic fungi, *Puccinia graminis* could, on the same basis, be split into a hundred or more species when one considers the physiologic races which have the capacity to attack certain host plants and not others.

2. **Ustilago Bistortarum** (De Candolle) Koernicke, Hedwigia **16**: 38. 1877.

Ustilago inflorescentiae Trelease, Harriman Alaska Exped., Crypt. Bot. Alaska **V**: 35. 1904.

Attacks leaves and flowers. Chlamydospores yellowish to brown-violet, globose or irregularly elongate, 10–16 μ diam. or 7–12 x 14–18 μ; epispore uniformly verrucose.

HOSTS: *Polygonum Bistorta* L. and *P. viviparum* L.

SPECIMENS EXAMINED: **Norway**: Tromsö, on *P. viviparum*, June 1895, *Lagerheim in* Sydow: Ustilagineen No. 3 (FH). — **Sweden**: Jemtland, on *P. viviparum*, 1 July 1930, *D. A. G. Eliasson in* Zillig: Ustilag. Europ. No. 117 as *U. ustilaginea* (DC) Liro (FH). — Jemtland, Hålland, on *P. viviparum*, July 1890, *in* T. Vestergren: Micromyc. Rar. Sel. No. 580 (FH). — Stockholm, on *P. viviparum*, 24 June 1891, *L. Romell in* Rómell: Fungi Exsic. Praes. Scandinav. No. 134 as *Sphacelotheca hydropiperis* (Schum.) DeBy. (FH). — **Germany**: Bavaria, Oberammergau, on *P. Bistorta*, May 1901, *B. Kaufman in* Sydow: Ustilagineen No. 190 (FH). — **Switzerland**: St. Moritz, on *P. viviparum in* Fuckel: Fungi Rhen. No. 2618 as *Ustilago Candollei* Tul. (FH). — **Czechoslovakia**: Bohemia, Toschow near Levin, on *P. Bistorta*, 31 May 1901 *in* Sydow: Ustilagineen No. 190 (FH). — **Russia**: Moscow, May 1893, *Sydow in* Sydow: Ustilagineen No. 3 (FH). — **United States**: **Wyoming**: Big Horn Mts., on *P. viviparum*, Aug. 1898, *Williams & Griffiths in* Griffiths: West Amer. Fungi No. 223 as *Sphacelotheca Hydropiperis* (FH). — **Colorado**: Seven Lakes, on *P. viviparum*, *in* Clements: Cryptog. Form. Colorado. No. 154 as *U. Bistortarum* var. *inflorescentiae* Trel. (FH).

Ustilago Bistortarum and *U. inflorescentiae* develop on the leaves and flowers of *P. Bistorta* and *P. viviparum* respectively. Observations on type or authentic material of these species revealed that they possess the same microscopic characters and that the only difference between the two species is their localization in certain organs of the host, — *U. Bistortarum* on the leaves and *U. inflorescentiae* on the flowers. In both species, the chlamydospores are brown-violet with a yellowish shade, globose or irregularly elongate 10–16 μ in diameter or 7–12 x 14–18 μ with the epispore 0.65–1.0 μ thick and uniformly verrucose. Both forms produce a three-celled basidium. These observations coincide with those of Linder (4) who studied the type of *U. inflorescentiae* and in referring to the ornamentation of the spores concludes ". . . the spores [of *U. inflorescentiae*] are just as pronouncedly ornamented as the specimens here placed in the species, and also are ornamented to the same degree as are the spores of *U. Bistortarum*."

Not considering localization of infection in an organ as a character sufficient to differentiate species, the writer proposes to place *U. inflorescentiae* in synonymy under *U. Bistortarum*.

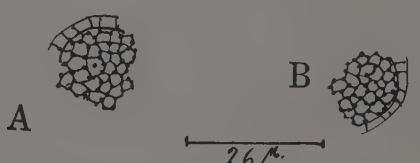
3. **Ustilago Parlatorei** Fischer v. Waldheim, Hedwigia **15**: 177. 1877.
Ustilago stygia Liro, Ann. Acad. Sci. Fenn. Ser. A **17**: 25. 1924.

PLATE I, FIGS. A-B; TEXT FIG. II, A-B

Attacks various parts of the host. Chlamydospores brown-violet to slightly yellowish, globose or irregular, 10–15 μ diam.; epispore deeply and irregularly reticulate with column-like structures which project at the angles of the reticulations.

HOSTS: *Rumex maritimus* L., *R. Acetosella* L., *R. Acetosa* L., *R. alpinus* L. and *R. britannicus* auct.

SPECIMENS EXAMINED: **Germany**: Hessen Nassau, Marburg, on *R. Acetosa*, 10 May 1926, *P. Claussen in* Zillig: Ustilag. Europ. No. 96 as *U. stygia* (FH). — **Switzerland**: Canton Uri, Meienthal, on *R. alpinus*, 27 Aug. 1907, *E. Fischer in* Sydow: Ustilagineen No. 405 (FH). — **Czechoslovakia**: Bohemia, Lundenburg, on *R. maritimus*, 8 March 1924, *R. Picbauer in* F. Petrak: Flora Bohem. et Morav Exs. Ser. H, Abt. 1, Lfg. 40, No. 1990 (FH). — **Russia**: Stepankowa, 25 km N.W. of Moscow, on *R. maritimus*, Sept. 1876, *Fischer v. Waldheim in* Rabenhorst: Fungi Europ. No. 2291, **type** of *U. Parlatorei* (FH). — **United States**: **Missouri**: Saline Co., Emma, on *R. britannicus*, 25 July 1894, *C. H. Demetrio in* Sydow: Ustilagineen No. 112 (FH). — Saline Co., Emma, on *R. britannicus*, *C. H. Demetrio in* Rabenhorst-Winter-Pazschke: Fungi Europ. No. 4009 (FH).



TEXT FIG. II. Camera lucida drawings to show the characteristics of (**A**) *Ustilago stygia* and (**B**) *Ustilago Parlatorei* from authentic and type material respectively.

Ustilago Parlatorei Fischer v. Waldheim and *U. stygia* Liro inhabit the same organs of the host plant and differ only to a minor degree in microscopic details. *U. Parlatorei* is briefly characterized as follows: chlamydospores brown to brown-violet or yellow (Maerz & Paul, Sudan brown to Argus, Pl. 14L to Pl. 17A12), globose or irregular, 10–14 μ diam., and with the epispore reticulate with column-like structures at the angles of the reticulation. *Ustilago stygia* differs from this only in that there is a slight variation in color and that the spores are 13–15 μ in diameter, the reticulations being somewhat larger. The slight differences do not justify keeping these species separate and it is therefore proposed to reduce *U. stygia* to synonymy under *U. Parlatorei*.

Ustilago Kuhneana Wolff on *Rumex Acetosella* is very similar to *U. Parlatorei* but its larger chlamydospores are more regularly reticulated and it does not form column-like structures at the junctions of the reticulations. Also, the larger wings of the reticulations at the margins make it advisable to keep the species separate until experimental studies can be made

to determine the validity of these characters as well as the range of variation.

SPECIES OF CINTRACTIA ON CAREX SPP. AND RHYNCHOSPORA SPP.

As in the case of the smuts on *Polygonum*, there are smuts which occur on *Rhynchospora* spp. and *Carex* spp. that have a great number of synonyms, some of which are reported below.

1. **Cintractia limosa** Sydow, Ann. Mycol. **22**: 288. 1924.
Cintractia turfosa Sydow, Ann. Mycol. **22**: 289. 1924.

PLATE IV. FIGS. F-G

Attacks the inflorescence. Chlamydospores brownish black to castaneous, globose or irregularly elongate, 19–24 μ diam. or 20–24 x 13–14 μ; 0.65–1.5 μ thick, granulate to almost smooth.

HOSTS: *Carex limosa* L. and *C. dioica* L.

SPECIMENS EXAMINED: **Norway**: Kaafjard, on *Carex dioica*, July 1895, *G. Lagerheim* as *C. Caricis in* Sydow: Ustilagineen No. 75 (FH). — Tromsö, on *Carex limosa*, Aug. 1894, *G. Lagerheim in* Sydow: Ustilagineen No. 76 (FH). — **Finland**: Lapponia, Peltovuoma, Peltojoki, on *Carex dioica*, 24 July 1933, *H. Roivainen & J. I. Liro in* Liro: Mycotheca Fenn. No. 31 as *Cintractia turfosa* (FH). — Alandia, Finstrom, Godby, on *Carex limosa*, 7 July 1919, *T. Putkonen in* Liro: Mycotheca Fenn. No. 29, as *Cintractia limosa* (FH). — Ostrobothnia, Turtola, Arajarvi, 21 July 1933, *H. Roivainen & J. I. Liro in* Liro: Mycotheca Fenn. No. 30 as *Cintractia limosa* (FH). — **Germany**: Berlin, on *Carex limosa*, Aug. 1887, *Sydow in* Sydow: Mycotheca Marchica No. 1514 as *Ustilago Caricis* (FH). — on *Carex limosa*, July 1895, *Sydow in* Sydow: Ustilagineen No. 77 (FH). — Paulsborn near Berlin, on *Carex limosa*, 28 July 1903, *Sydow in* Sydow: Mycotheca German. No. 219 as *Cintractia caricis* (FH).

From a comparison of type material of *Cintractia limosa* Sydow and *C. turfosa* Sydow which parasitize *Carex limosa* and *C. dioica* respectively, there appears to be a very close relationship between the two species. Both species have brown-blackish to castaneous and globose to irregularly elongate spores. They differ in that the chlamydospores of *C. limosa* measure 19–21 μ diam. or 20–22 x 14 μ with a granulate to almost smooth epispore that is 1.3 to 1.5 μ thick. The spores of *C. turfosa* measure 20–24 μ diam. or 20–24 x 13–14 μ and the epispore is 0.65 to 1.3 μ thick. It is obvious that only very slight differences exist between the two species and they are not sufficient to warrant segregating the species. A study of other specimens of these species showed that there are variations within the same species which are greater than those between the two species. Therefore it is proposed to reduce *Cintractia turfosa* to synonymy under *C. limosa* since the latter has priority by one page in the same article.

Cintractia limosa is very similar to *C. Caricis*, but lack of type material prevents a comparison that would enable the writer to draw definite conclusions.

2. **Cintractia utriculicola** (Henn.) Clint., Journ. Mycol. **8**: 143. 1902.
Cintractia Rhynchosporae Ciferri, Arkiv f. Botanik **23**(14): 9. 1931.

PLATE II, FIGS. A–B

Sori in the inflorescence, transforming the ovaries into a blackish chlamydosporic mass. Chlamydospores olivaceous-brown, lighter at the center, globose to slightly irregular, 11–16 μ diam., epispore 1.3–1.95 μ thick, smooth.

HOSTS: *Rhynchospora corymbosa* (L.) Britt. and *Rhynchospora* sp.
Cintractia utriculicola (Henn.) Clint., *C. Rhynchosporae* Cif. and *C. limitata* Clint. produce their sori in the inflorescence of *Rhynchospora corymbosa*, *Rhynchospora* sp. and *Cyperus lijurius* respectively. The chlamydospores of the three species are very similar, as is indicated in Table II.

TABLE II. MICROSCOPIC CHARACTERS OF C. UTRICULICOLA, C. RHYNCHOSPORAE, AND C. LIMITATA

SPECIES	COLOR	FORM	DIAMETER	EPISPORE
C. utriculicola	brown olivaceous (Partridge to umber)	globose to irregular	13–16 μ	smooth, 1.3–1.95 μ thick
C. Rhynchosporae	as above	as above	11–16 μ	as above
C. limitata	as above but slightly darker at epispore	as above	10–13 μ	smooth, 0.65–1.3 μ thick

It is evident that *C. utriculicola* and *C. Rhynchosporae* are the same morphologic species. The only difference is that the fungous membrane which covers the sorus of *C. Rhynchosporae* is thinner, a difference which does not in itself furnish a character stable enough to use in differentiating species since it varies with the host. It is therefore proposed to place *C. Rhynchosporae* in synonymy under *C. utriculicola*.

C. Rhynchosporae was reduced by Zundel to synonymy with *C. Montagnei* but the echinulations of the chlamydospores of this latter species marks it as distinct.

C. limitata produces chlamydospores which are slightly darker, slightly smaller and with thinner epispores than those of *C. utriculicola*. The sori are restricted to the glumes. Such differences should not be considered as more than varietal and for this reason the writer proposes the following new combination.

3. **Cintractia utriculicola** (Henn.) Clint. var. **limitata** (Clint.) Hirsch. comb. nov.
Cintractia limitata Clint. Proc. Boston Soc. Nat. Hist. **31**: 399. 1904.

PLATE II, FIG. C

4. **Cintractia Montagnei** (Tul.) Magnus, Abhandl. Bot. Ver. Prov. Brandenb. **37**: 79. 1896.

Cintractia gigantospora Liro, Ann. Acad. Sci. Fenn. Ser. A **42**: 47. 1935–38.

Cintractia Montagnei (Tul.) Magnus and *C. gigantospora* Liro both attack the ovaries of *Rhynchospora alba* and their macro- and microscopic characters are alike, according to studies based on type and authentic material. Liro (*op. cit.*) includes *C. Montagnei* as a synonym of *C. gigantospora* but according to the rules of priority it is the latter that should fall into synonymy.

HOST: *Rhynchospora alba* Vahl.

SPECIMENS STUDIED: **Finland**: Alandia, Finström, Storträsk, on *Rhynchospora alba*, 26 July 1897, *A. S. Kajava & J. I. Liro in* Liro: Mycotheca Fenn. No. 26, **type** of *Cintractia gigantospora* (FH). — **Germany**: Siegsburg, on *Rhynchospora alba*, 1873, *Körnicke in* Thuemen: Mycotheca Univ. No. 929 (FH).

5. **Cintractia microsora** Sydow, Ann. Mycol. **22**: 289. 1924.

Cintractia aspera Liro, Ann. Acad. Sci. Fenn. Ser. A **42**: 18. 1938.

Attacks the inflorescence. Chlamydospores olivaceous black, subglobose or irregularly elongate, 17–22 μ diam. or 7–19 x 19–22 μ; epispore granulate and 1.3–2.6 μ thick.

HOSTS: *Carex chordorrhiza* L. and *C. remota* L.

SPECIMENS EXAMINED: **Finland**: Kittilä, Sirkankylä, on *Carex chordorrhiza*, 28 July, 1933, *Roivainen & Liro in* Liro: Mycotheca Fenn. No. 41, **type** of *Cintractia aspera* (FH). — **Japan**: Musashi Prov., Takao, on *Carex remota*, 8 May 1899, *S. Kusano in* Sydow: Ustilagineen No. 223, **type** of *Cintractia microsora* (FH).

Cintractia aspera and *C. microsora* are parasitic in the inflorescence of *Carex chordorrhiza* and *Carex remota* respectively. The color and shape of the chlamydospores of the two species and the granulate epispore are alike in both species. The chlamydospores differ only in size, those of *C. microsora* being 19–22 μ diam. or 11–19 x 19–22 μ and those of *C. aspera* 17–22 μ diam. or 7–16 x 19–22 μ. The epispores of *C. microsora* measure 1.3–2.6 μ thick and those of *C. aspera* 1.95–2.6 μ. Thus the difference between the two species is very slight. Furthermore, the fact that there are a greater number of roundish spores, and that there is less pronounced ornamentation, and the epispore of *C. aspera* is thinner, does not warrant the segregation of the two species even though they parasitize different host species. For this reason, *C. aspera* is reduced to synonymy under *C. microsora*.

6. **Cintractia arenaria** Sydow, Ann. Mycol. **22**: 289. 1924.

Ustilago Caricis var. *leioderma* Lagerheim, Mitt. Bad. Bot. Ver. No. 55–56: 37. 1888.

Cintractia lejoderma (Lagerheim) Ciferri, Ann. Mycol. **29**: 43–45. 1931.

PLATE II, FIGS. D–E

Sori in the inflorescence. Chlamydospores olivaceous brown, subglobose or irregularly polygonal, 16–18 μ diam. or 13–15 x 16–20 μ; epispore smooth.

HOSTS: *Carex brizoides* L., *C. arenaria* L. and *C. leporina* L.

SPECIMENS EXAMINED: **Germany**: Pomerania, Kreis Usedom-Wollin near Misdroy, on *Carex arenaria*, 29 Aug. 1923, *M. Noack in* Zillig: Ustilag. Europ. No. 2 as *Cintractia Caricis* (FH). — Pomerania, Rügenwaldermünde, on *Carex arenaria*, July 1893, *Sydow in* Sydow: Ustilagineen No. 14 as *Ustilago olivacea*, authentic material of *Cintractia arenaria* (FH). — Island of Sylt, Westerland, on *Carex arenaria*, 6 Aug. 1911, *Sydow in* Sydow: Ustilagineen No. 442, authentic material of *Cintractia arenaria* (FH). — **Hungary**: Pozsony, Bratislava [Presburg], on *Carex leporina*, July 1913, *A. Bäumler in* Zillig: Ustilag. Europ. No. 74 as *Cintractia Caricis* (FH). — **Czechoslovakia**: Moravia, Doubrava near Schwarzbach, on *Carex brizoides*, 17 July 1897, *Fr. Bubák in* Sydow: Ustilagineen No. 178, **type** of *Cintractia leioderma* (FH). — Ribar near Weisskirchen, on *Carex brizoides*, 28 June 1926, *F. Petrak in* Zillig: Ustilag. Europ. No. 71 as *Cintractia Caricis* (FH).

Studies of type and authentic material of *Cintractia leioderma* and *C. arenaria* leave little doubt that they are the same species. Both species produce their sori in the ovaries, and nearly all their microscopical characters are the same. The only difference is that in *C. leioderma* the spores measure 16–18 μ diam. or 13–15 x 19–22 μ whereas those of *C. arenaria* measure 15–17 μ diam. or 11–13 x 16–20 μ. The fact that these two species developed on different hosts without change of microscopic characters, except for differences in size, would indicate that they are the same species, and therefore the writer proposes to consolidate the species and retain *Cintractia arenaria* Sydow as the valid name.

INSTITUTO DE BOTÁNICA "SPEGAZZINI"
LA PLATA, ARGENTINA

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EXPLANATION OF PLATE I

All photomicrographs were made at the same magnification.

A. *Ustilago Parlatorei*, spores from type material.
B. *Ustilago stygia*, spores from authentic material.
C. *Ustilago Zeae*.
D. *Ustilago Euchlaenae*, spores from type material.
E. *Ustilago hypodytes*, spores from lectotype.
F. *Ustilago persicariae*, spores from type material.
G. *Ustilago anomala*, spores from type material.
H. *Ustilago Cordai*.
I. *Ustilago muricata*.
J. *Ustilago carnea*.

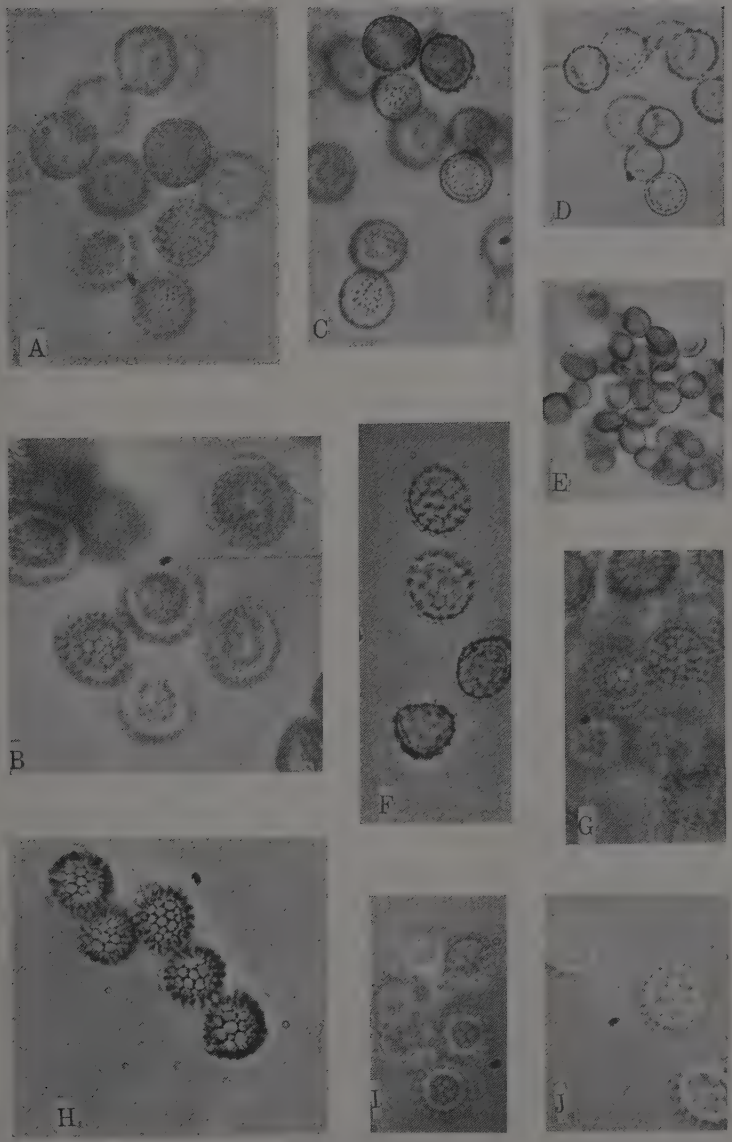


PLATE I

EXPLANATION OF PLATE II

All photomicrographs were made at the same magnification.

A. *Cintractia utriculicola*, spores from authentic material.
B. *Cintractia Rhynchosporae*, spores from type material.
C. *Cintractia utriculicola* var. *limitata*, spores from type material.
D. *Cintractia leioderma*, spores from type material.
E. *Cintractia arenaria*, spores from type material.
F. *Cintractia turfosa*, spores from type material.
G. *Cintractia limosa*, spores from type material.

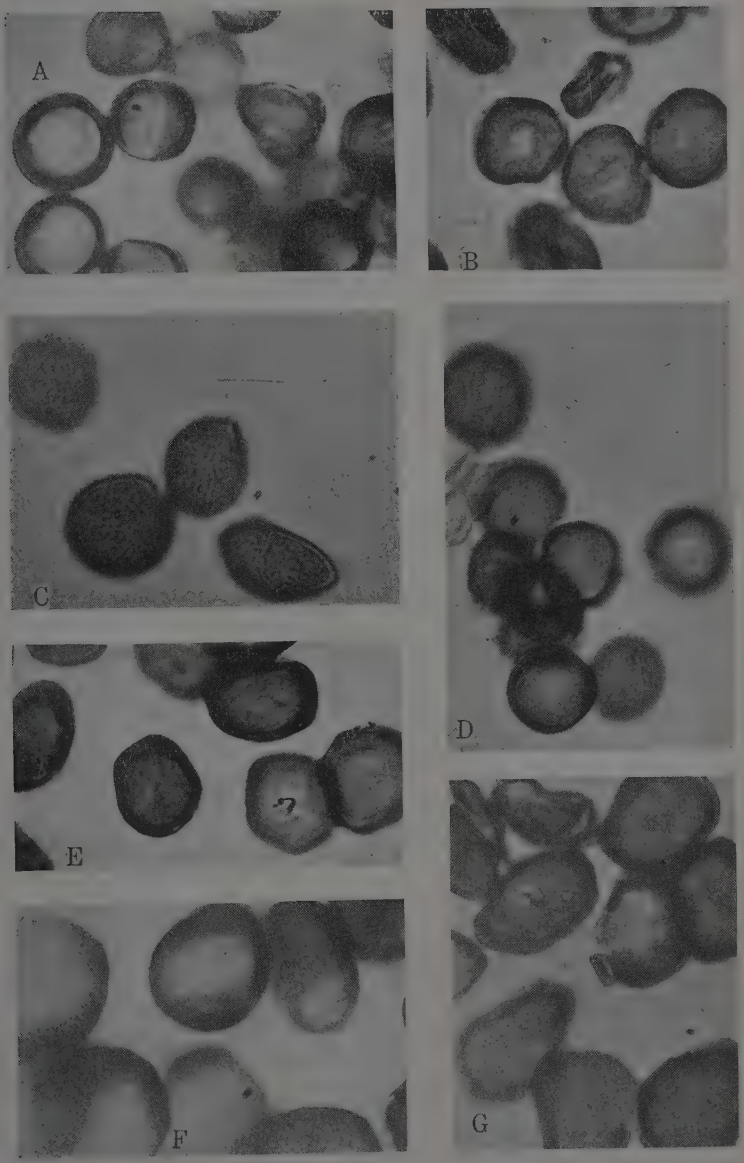


PLATE II

EXPLANATION OF PLATE III

Ustilago Euchlaenae, isotype specimen in Anzi *et al.*, Erb. Critt. Ital. Ser. II, No. 1152 (FH).

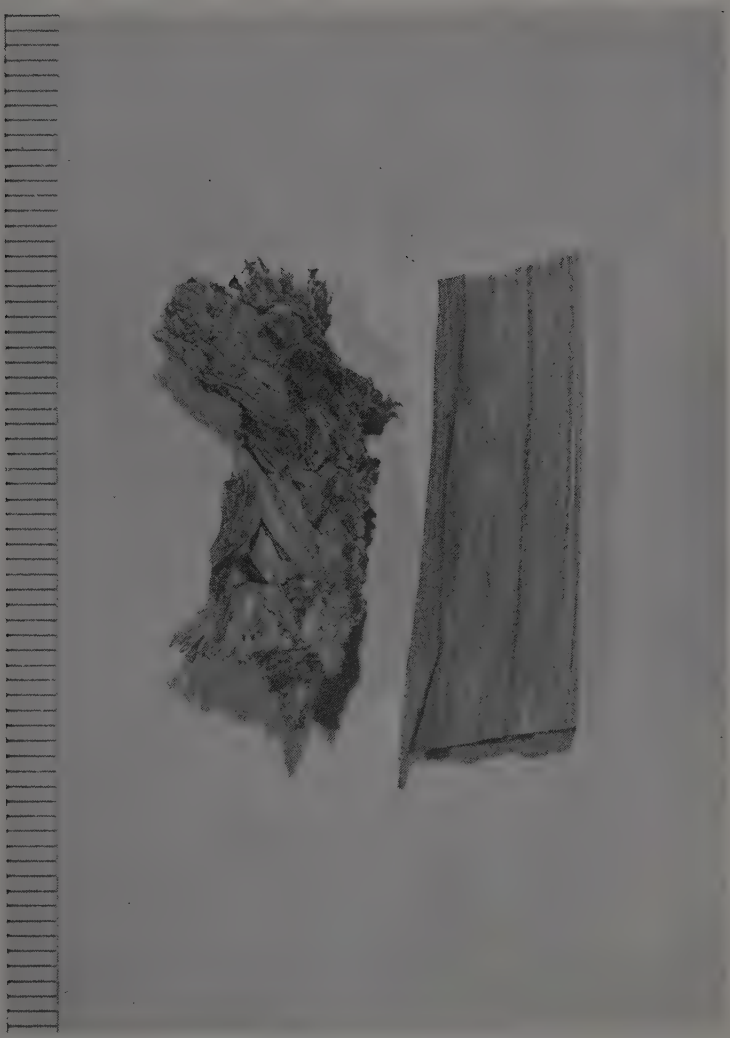


PLATE III

EXPLANATION OF PLATE IV

Ustilago Kellermanii on *Euchlaena mexicana* (Bureau Plant Industry 60395).

PLATE IV

3(1):95–139 FARLOWIA JANUARY, 1947

UREDINALES OF WESTERN CHINA [1]

F. L. TAI [2]

Little is known of the rusts of China, especially those of the western part. Delavay collected 13 species of rust fungi during his stay in Yunnan at the later part of the last century and 24 species were collected by Handel-Mazzetti in his collection trips in southwestern China during the first world war. This paper presents results of a study of rust collections made in the province of Yunnan. Included also are species from Szechuan, Hunan, Kweichow, Kansu and other provinces. Of the 213 species, which are distributed in 25 genera, and include 25 new species, 164 species are from Yunnan.

Because of the limitation of space, full data of the collections, except in the case of new species, are omitted. It should be mentioned that the collections of Yunnan were made by the writer and colleagues of this Division, also by Prof. L. T. Lin and Mr. T. H. Hung of the Sunyatsen University; those of Hunan by Messrs. C. C. Cheo and S. T. Chao; of Szechuan by Dr. L. Ling and his associates; and of Kansu by Mr. W. L. Hsian.

There is much confusion, as will be seen in the following pages, between certain species. It seems that many of the species, which have been described by European mycologists on poor and scanty material from Asia, need further study.

MELAMPSORACEAE

HYALOPSORA Magnus

Hyalopsora Polypodii (Diet.) Magnus

On *Dryopteris* sp. **Yunnan**: Shishan, Kunming, *4997*.[3]

MILESINA Magnus

Milesina erythrosora (Faull) Hiratsuka f.

On *Dryopteris* sp. **Yunnan**: Shishan, Kunming, *5686*.

PUCCINIASTRUM Otth

Pucciniastrum Agrimoniae (Diet.) Tranzsch.

On *Agrimonia zeylanica*. **Yunnan**: Hsiakwan, Tali, *4371*; **Hunan**: Hengshăn, *4750*.

[1] Paper No. 26 from the Division of Plant Pathology, Institute of Agricultural Research, National Tsing Hua University, Kunming, Yunnan, China.

[2] The writer is indebted to Drs. W. Tranzschel, B. B. Mundkur, G. B. Cummins, H. Sydow, K. Boedijn, L. S. Berus, L. Ling, T. N. Liou, H. K. Chen, C. T. Wei, and Prof. L. T. Lin for sending specimens, and also to Mr. C. Y. Wu for determination of hosts and a number of collections.

[3] This refers to the Plant Pathology Herbarium number, Tsing Hua University.

Pucciniastrum Coriariae Diet.

On *Coriaria sinica*. **Szechuan**: Kwanhsien, *8406*, *8407*.

Pucciniastrum Castaneae Diet.

On *Castanea mollissima*. **Yunnan**: Kunming *5246*; **Szechuan**: Chengtu, *6821*. On *C. Henryi*. **Hunan**: Yolushan, Changsha, *4417*, *4512*, *4522*.

MELAMPSORIDIUM Klebahn

Melampsoridium Alni (Thuem.) Diet.

On *Alnus cremastogene*. **Szechuan**: Kwanhsien, *8405*.

CRONARTIUM Fries

Cronartium gentianeum Thuem.

On *Gentiana rigescens*. **Yunnan**: Changshan, Tali, *5070*; Chichushan, Pinchuan, *5069*.

Uredia hypophyllous, irregularly gregarious to scattered, roundish, bullate, at first covered by epidermis, then ruptured by an apical pore, 0.2–0.35 mm. in diameter, pale cinnamon brown; *uredospores* subglobose, ovate to ellipsoid, epispore 1.5–2 μ thick, subhyaline, sparsely and finely echinulate, 24–30 x 17–21 μ. *Telia* hypophyllous, gregarious, cylindrical, straight or slightly curved, pale cinnamon brown, 0.5–1.5 mm. long, 83–200 μ broad; *teliospores* oblong or cylindrical, obtuse at both ends, epispore yellowish, smooth, about 1 μ thick, 34–51 x 10–14 μ, germinating immediately; *sporidia* globose, 7.0–8.6 μ in diameter.

Cronartium Delavayi Pat. (Rev. Mycol. 8:80. 1886) was described by Patouillard on collections from western Yunnan. Morphologically it is not distinct from *C. gentianeum* Thuem., and is here considered as a synonym of the latter.

Cronartium Quercuum Miyabe

On *Quercus acutissima*. **Yunnan**: Wenshan, *4434*; **Kweichow**: Meitan, *7935*.

Cronartium flaccidum (Alb. et Schw.) Winter

On *Delphinium Delavayi*. **Yunnan**: Changshan, Tali, *4621*; Chichushan, Pinchuan, *4332*.

Cronartium Keteleeriae sp. nov.

FIGURE 1

On *Ketcleeria Elveyniana*. **Yunnan**: Shishan, Kunming, June 30, 1938, *C. C. Cheo* & *S. T. Chao*, *4638*, **type!**, *4429*, *4637*, *4639*.

Teliis hypophyllis, sparsis vel aggregatis, cylindraceis, plus minusve compressis, rectis vel parum curvatis, 2.5–6 mm. longis, 250–625 μ latis, "cadmium orange" (Ridgway); *teliosporis* fusiformibus vel oblongo-fusiformibus, utrinque acutis, levibus, hyalinis, 23–37 x 10–16 μ, *episporio* 1.5–2.5 μ crasso; *sporidiolis* globosis, 6–7 μ in diam.

CHRYSOMYXA Unger

Chrysomyxa Dietelii Syd.

On *Rhododendron trichocladum*. **Yunnan**: Changshan, Tali, *8161*.

Chrysomyxa Rhododendri De Bary

On *Rhododendron decorum*. **Yunnan**: Chichushan, Pinchuan, *8159*. On *R. Faberi*. **Szechuan**: Omeishan, *8424*.

PHAKOPSORA Dietel

Phakopsora Artemisiae Hiratsuka f.

On *Artemisia Dracunculus*. **Yunnan**: Kunming, *5051*. On *A. parviflora*. **Yunnan:** Kunming, *7962*. On *A. verbenacea*? **Yunnan**: Tapuchi, Kunming, *5074*.

Uredia amphigenous, mostly epiphyllous, gregarious in groups or scattered, roundish, 0.25–0.35 mm. in diameter, at first covered by epidermis, finally ruptured by a central pore or irregularly, pulverulent, cinnamon brown; *uredospores* globoid, ellipsoid or piriform, epispore 1.5–2 μ thick, echinulate, pale cinnamon brown or subhyaline, 24–39 x 16–26 μ; *pores* indistinct; *paraphyses* peripheral, straight or curved, clavate, hyaline, 41–64 x 6–10 μ.

Telia amphigenous, mainly hypophyllous, gregarious or scattered, minute, 0.1–0.2 mm. in diameter, often forming a ring around uredium, covered by epidermis, brownish-black or black; *teliospores* in 2–4 superposed layers, lentiform, oblong or broadly ovate, epispore cinnamon brown or paler below, chestnut brown at apex, 1–1.5 μ thick at sides, 3–7 μ thick at apex, 24–40 x 11–18 μ.

Phakopsora compositarum Miyake is stated by Hiratsuka to differ from *P. Artemisiae* in the hypophyllous uredia, smaller uredospores and much longer teliospores. The former has been reported again from North China by Liou and Wang (Contr. Inst. Bot. Nat. Acad. Peiping **3**: 347–348. 1936) on *Artemisia, Chrysanthemum, Saussurea* and *Aster*. They found only the telial stage and gave the size of the teliospore as "25–50 x 10–19." The teliospores of the Yunnan plant are slightly longer than in *P. Artemisiae*, but shorter than *P. compositarum*. The measurements of the uredospores, however, accord well with those of *P. Artemisiae* which may prove to be identical with *P. compositarum*.

Phakopsora punctiformis (Barcl. et Diet.) Diet.

On *Galium asperifolium*. **Yunnan**: Tapuchi, Kunming, *8157*.

Phakopsora Ziziphi-vulgaris Diet.

On *Zizyphus sativa*. **Yunnan**: Hualing, *4821*. On *Paliurus* sp. **Szechuan**: Chengtu, *6840*.

Phakopsora Pachyrhizi Syd.

On *Pachyrhizus bulbosus*. **Yunnan**: I-Liang, *5149*. On *Glycine hispida*. **Yunnan**: Kunming, *4416*, *7655*; Hualing, *4873*; **Hunan**: Hengshan, *4661*. On *Pueraria Thunbergiana*. **Hunan**: Hengshan *4043*, *4044*.

Uromyces Sojae (P. Henn.) Syd. is synonymous with *U. Mucunae* Rabh. as has been pointed out by Butler and Bisby (Fungi of India p. 83. 1931); the host, erroneously identified as *Glycine Soja*, on which the combination, *U. Sojae* was made, proves to be *Mucuna* sp. and the fungus is *U. Mucunae* Rabh.

The uredospores of the Chinese forms are slightly larger, and the teliospores smaller than those given in the original diagnosis.

Phakopsora Ampelopsidis Diet. et Syd.

On *Vitis vinifera*. **Yunnan**: Lunan, *4367*; **Kansu**: Tienshui, *8422*. On *V. betulifolia*. **Szechuan**: Chengtu, *8430*.

Phakopsora hengshanensis sp. nov.

On *Ficus Martini*? **Hunan**: Hengshan, Nov. 18, 1937, *C. C. Cheo*, *4757*, **type!** On *F. heteromorpha*. **Hunan**: Hengshan, *4758*.

Urediis hypophyllis, sparsis vel subaggregatis, rotundatis vel irregularibus, 0.25–0.5 mm. latis, diu epidermide tectis, tandem poro centrali apertis, flavo-aurantiacis, paraphysibus numerosis, capitatis, 29–34 μ longis, 7–8.6 μ latis, hyalinis; *uredosporis* subglobosis vel ellipsoideis, subhyalinis, subtiliter verruculosis, 20–24 x 16–21 μ, episporio 1–1.5 μ crasso. *Teliis* hypophyllis, sparsis vel aggregatis, saepe confluentibus, laxe aut circulariter aggregatis, subepidermicis, rotundatis, 0.5–1 mm. diam., atro-brunneis; *teliosporis* 2–4 superpositis, cubicis, oblongis vel cylindraceis, 20–31 x 8.6–14 μ, episporio brunneolo, 1–1.5 μ crasso, ad apicem 2–3 μ crasso.

COLEOSPORIUM Lev.

ON ORCHIDACEAE

Coleosporium Arundinae Syd.

On *Spathoglottis pubescens*. **Yunnan**: Changshan, Tali, *5059*. On Orchidaceae. **Yunnan**: Changshan, Tali, *5060*.

The plants of these collections agree closely with *C. Arundinae* except that the uredospores are longer and slightly narrower (17–34–(40) x 14–23 μ) than those of the latter ("20–24 x 18–24 μ").

Coleosporium Bletiae Diet.

On Orchidaceae. **Yunnan**: Hsiakwan, Tali, *5061*. The uredospores of this form are slightly longer (21–31 x 15–20) than those of *C. Bletiae*. *C. Merrillii*, differing from the former only in the slightly shorter teliospores, may be synonymous.

ON RANUNCULACEAE

Coleosporium Aconiti Thuem.

On *Aconitum Vilmorinianum*. **Yunnan**: Chichushan, Pinchuan, *4618*.

Coleosporium Cimicifugatum Thuem.

On *Cimicifuga foetida*. **Yunnan**: Chichushan, Pinchuan, *4619*.

Coleosporium Clematidis Barcl.

On *Clematis Peterae*. **Yunnan**: Kunming, *4806*, *4839*, *6896*, *7808*. On *C. chrysocoma*. **Yunnan**: Kunming, *4769*. On *C. brevicaudata*. **Yunnan**: Kunming, *4846*. On *C. montana*. **Yunnan**: Hsiakwan, Tali, *4433*. On *C.* sp. **Yunnan**: Hsiakwan, Tali, *4542*; **Szechuan**: Omeishan, *6845*.

ON SAXIFRAGACEAE

Coleosporium Fauriae Syd.

On Saxifragaceae. **Yunnan**: Changshan, Tali, *5039*.

Uredia hypophyllous on angular yellow spots 2.5–5 mm. wide, circinately arranged, roundish, naked, surrounded by ruptured epidermis, 0.35–0.8 mm. in diameter, pulverulent, whitish; *uredospores* subglobose, ovoid, ellipsoid or rarely oblong, densely verrucose, epispore 1.5–2 μ thick, hyaline, 21–43 x 16–24 μ. *Telia* hypophyllous, usually gregarious in small groups (2–4 mm. wide), 0.35–0.5 mm. in diameter, often confluent, yellowish or brownish yellow, plane; *teliospores* clavate-cylindrical, apex thickened up to 20 μ thick, 62–100 x 19–25 μ.

ON GERANIACEAE

Coleosporium Geranii Pat.

On *Geranium strigosum*. **Yunnan**: Changshan, Tali, *4648*, *5063*, *5064*.

Telia hypophyllous, densely gregarious or scattered, often circinately arranged, confluent, roundish, 0.5–0.8 mm. in diameter, ochraceous buff, sometimes becoming black; *teliospores* cylindrical-clavate, rounded at apex, slightly attenuated at the base, 60–80 x 16–23 μ, apex 10–20 μ thick. This species was first described from western Yunnan by Patouillard in 1890 (Rev. Mycol. **12**: 135. 1890).

Coleosporium Evodiae Diet.

On *Evodia rutaecarpa*. **Hunan**: Yolushan, Changsha, *4502*, *4516*, *4571*. On *E. officinalis*. **Szechuan**: Kiating, *6854*. On *E.* sp. **Szechuan**: Kwanhsien, *8482*.

Coleosporium Xanthoxyli Diet. et Syd.

On *Xanthoxylum acanthopodium*. **Yunnan**: Shishan, Kunming, *7484*. On *X. alatum*. **Yunnan**: Wenshan, *4855*, *4856*, *4857*; Tachwang, *4349*; **Hunan**: Yolushan, Changsha, *4570*, *4686*.

ON LABIATAE

Coleosporium Plectranthi Barcl.

On *Plectranthus Bulleyanus*. **Yunnan**: Hsiakwan, Tali, *4561*. On *P. Coetsa*. **Yunnan**: Changshan, Tali, *4345*, *4559*; Chichushan, Pinchuan, *4556*. On *P. eriocalyx*. **Yunnan**: Kunming, *8081*, *8082*. On *P. phyllop-*

odus. **Yunnan**: Changshan, Tali, *4347*, *4560*, *4566*; Chichushan, Pinchuan, *4555*. On *P. sculponeatus*. **Yunnan**: Kunming, *4462*, *4544*, *8080*; Wenshan, *4346*, *4348*; Hsiakwan, Tali, *4562*. On *P. striatus*. **Yunnan**: Changshan, Tali, *4565*. On *P. nervosus*. **Szechuan**: Chengtu, *7541*.

Coleosporium Perillae Syd.

On *Perilla nankinensis*. **Yunnan**: Kunming, *5147*; **Szechuan**: Chengtu, *7540*. On *P. frutescens*. **Szechuan**: Chengtu, *6861*. On *Elsholtzia rugulosa*. **Yunnan**: Hsiakwan, Tali, *4561a*. On *E. Patrini*. **Yunnan**: Kunming, *4461*. On *E. ochroleuca*. **Yunnan**: Tali, *4563*.

ON SCROPHULARIACEAE

Coleosporium Pedicularidis sp. nov.

On *Pedicularis gracilis*. **Yunnan**: Changshan, Tali, August 24, 1938, *C. C. Cheo*, *4354*, **type!** *4457*. On *P. deltoides*. **Yunnan**: Tali, *4557*. On *P. racemosa*. **Yunnan**: Chichushan, Pinchuan, *4458*.

Uredii amphigenis, plerumque hypophyllis, aggregatis vel sparsis, rotundatis, 0.25–0.7 mm. diam., pallide flavis, mox nudis, pulverulentis; *uredospori* subglobosis, ovatis, ellipsoideis vel oblongis, grosse verrucosis, 18–30 x 13–20 μ, episporio 1.5–2 μ crasso.

Teliis amphigenis, dense gregariis vel sparsis, rotundatis, 0.2–0.5 mm. diam., ochraceis; *teliospori* cylindraceis vel clavatis, apice modice incrassatis usque 13 μ, 54–83 x 17–26 μ.

ON RUBIACEAE

Coleosporium Leptodermidis (Barcl.) Syd.

On *Leptodermis glomerata*. **Yunnan**: Shishan, Kunming, *4344*. On *L. Potanini*. **Yunnan**: Changshan, Tali, *4343*, *5047*. On *L. Potanini* var. *glauca*. **Yunnan**: Changshan, Tali, *4548*. On *L. Potanini* var. *tomentella*. **Yunnan**: Kunming, *7483*, *8257*; Changshan, Tali, *4558*. On *L. pilosa* var. *microphylla*. **Yunnan**: Hsiakwan, Tali, *4538*.

Coleosporium Paederiae Diet.

On *Paederia foetida*. **Yunnan**: Tapuchi, Kunming, *8145*, *8146*.

Uredia hypophyllous, scattered, roundish, 0.3–0.5 mm. in diameter, naked, pulverulent; *uredospores* subglobose, ovate or ellipsoid, epispore 1.5–2 μ thick, hyaline, densely verrucose, 20–27 x 16–21 μ. *Telia* densely gregarious to scattered, ochraceous buff, roundish, or irregular in shape, usually confluent, 0.5–0.8 mm. in diameter; *teliospores* cylindrical, rounded at both ends, not or slightly narrowed toward the base, apex 7–10 μ swollen up to 27 μ thick, 64–99 x 18–23 μ.

This species was first discovered in Japan. It seems that only the uredial stage has been described.

ON CAMPANULACEAE

Coleosporium Campanulae (Pers.) Lev.

On *Asyneuma fulgens*. **Yunnan**: Kunming, *7479*; Hsiakwan, Tali, *4433a*. On *Wahlenbergia marginata*. **Yunnan**: Kunming, *8201*.

ON COMPOSITAE

Coleosporium Eupatorii Arth.

On *Eupatorium Lindleyanum*. **Kiangsu**: Nanking, *8436*.

Uredia hypophyllous, gregarious or scattered, sometimes circinately arranged, 0.35–0.5 mm. in diameter, roundish or irregular, finally naked, pulverulent, whitish when old; *uredospores* subglobose, ovate or ellipsoid, coarsely verrucose, epispore 1.5–2 μ thick, hyaline, 21–36 x 16–23 μ. *Telia* hypophyllous, densely gregarious in groups (1.5–3 mm. in diam.), 0.35–0.5 mm. in diameter, cinnamon brown, often surrounding uredia; *teliospores* cylindrical or cylindrical-clavate, yellowish, apex thickened (6–14 μ), 57–74 x 11–18 μ.

Coleosporium Carpesii Sacc.

On *Carpesium abrotaniodes*. **Yunnan**: Kunming, *8147*. On *C. cernum*. **Yunnan**: Wenshan, *4340*, *4341*; **Szechuan**: Omeishan, *6855*. On *C.* sp. **Yunnan**: Kaiyuan, *4809*.

Coleosporium Solidaginis Thuem.

On *Aster* sp. **Yunnan**: Kunming, *4336*, *4337*, *4338*; Kaiyuan, *4339*; Changshan, Tali, *4335*; **Hunan**: Yolushan, Changsha, *4482*. On *Callistephus chinensis*. **Yunnan**: Kunming, *4524*.

Coleosporium Inulae (Kunz.) Rabh.

On *Inula serrata*. **Yunnan**: Kunming, *8152*, *8158*.

Coleosporium Ligulariae Thuem.

On *Ligularia dictyoneura*. **Yunnan**: Changshan, Tali, *4539*. On *L. lapathifolius*. **Yunnan**: Kunming, *7478*.

Coleosporium Saussureae Thuem.

On *Saussurea peduncularis*. **Yunnan**: Chichushan, Pinchuan, *4473*, *4545*.

Coleosporium Senecionis Fr.

On *Senecio dianthus*. **Yunnan**: Chichushan, Pinchuan, *4464*. On *S. densiflorus*. **Szechuan**: Wenshan, *8483*.

MELAMPSORA Cast.

Melampsora Kusanoi Diet.

On *Hypericum patulum*. **Yunnan**: Kunming, *4469*, *4471*, *4850*, *6987*, *7604*, *8045*, *8756*; Chengkung, *7618*; Süanwei, *2046*. On *H. patulum* var. *Henryi*. **Yunnan**: Kunming, *4547*, *6894*.

Melampsora Ricini Pass.

On *Ricinus communis*. **Yunnan**: Kunming, *6879*; Kaiyuan, *5158*; Chengkiang, *4360*; Mengtze, *4862*; Lunan, *4361*; Tachwang, *4359*.

Melampsora coleosporoides Diet.

On *Salix heteromera*. **Yunnan**: Kunming, *7816*, *8484*, *5177*. On *S.* sp. **Yunnan**: Shihping, *6935*.

Melampsora Larici-epitea Kleb.

On *Salix Delavayana*. **Yunnan**: Changshan, Tali, *4552*. On *S. psilostigma*. **Yunnan**: Changshan, Tali, *4352*, *4353*, *4554*. On *S. longiflora*. **Yunnan**: Changshan, Tali, *4553*.

Melampsora Salicis-albae Kleb.

On *Salix* sp. **Yunnan**: Kunming, *8485*; **Szechuan**: Chengtu, *6823*.

Melampsora Salicis-Cavaleriei sp. nov.

FIGURE 2

On *Salix Cavaleriei*. **Yunnan**: Kunming, Nov. 10, 1942, *W. F. Chiu*, *7607*, **type**! *8486*.

Uredíis epiphyllis, sparsis vel subgregariis, rotundatis, 0.2–0.5 mm. diam., mox nudis, aurantiacis; *uredosporis* angulato-subglobosis, oblongis vel clavatis, verrucosis, 18–37 x 11–18 μ, *episporio* 1.5–2 μ crasso, hyalino; *paraphysibus* capitatis, hyalinis.

Teliis epiphyllis, sparsis vel dense aggregatis, rotundatis, 0.2–0.5 mm. diam., pallide cinnamomeo-brunneis, subepidermicis; *teliosporis* cylindraceis, prismaticis vel clavato-cylindraceis, flavidis, apice truncatis vel rotundatis, 36–69 x 7–11 μ, *episporio* ubique 1–1.5 μ crasso.

This fungus is characterized by its epiphyllous uredia and telia, slender teliospores and angular uredospores. It differs from *M. Salicis-albae* in the epiphyllous uredia and telia and much longer teliospores.

Melampsora Rostrupii Wagner

On *Populus rotundifolia*. **Yunnan**: Kunming, *7579*. On *P.* sp. **Yunnan**: Changshan, Tali, *4358*.

Melampsora Larici-populina Kleb.

On *Populus yunnanensis*. **Yunnan**: Hsiakwan, Tali, *4357*; I-Liang, *4351*; Kunming, *4877*; Chichushan, Pinchuan, *4463*.

CEROTELIUM Arthur

Cerotelium Fici (Cast.) Arth.

On *Morus* sp. **Yunnan**: Kaiyuan, *4867*, *5157*, *5181*; Mengtze, *5156*.

Cerotelium desmium (Berk. et Br.) Arth.

On *Gossypium barbadense*. **Yunnan**: Kaiyuan, *4860*, *4868*, *4809*, *4870*; Shihping, *6371*.

PUCCINIACEAE

GERWASIA Raciborski

Gerwasia Rosae sp. nov.

FIGURE 5

On *Rosa cymosa* (=*R. microcarpa*). **Hunan**: Hengshan, Nov. 3, 1937, *C. C. Cheo, 4514,* **type**! and *4701.*

Teliis hypophyllis, subaggregatis vel sparsis, minutis, 0.17–0.25 mm. diam., subepidermicis, per stomata erumpentis, pulvinatis, pallidis; *teliosporis* in apice hypharum per stomata fasciculatarum erumpentium ortis, ovoideis vel ellipsoideis, 26–41 x 11–16 μ, *episporio* tenui, hyalino, levibus, pedicello brevi, statim germinantibus; *paraphysibus* peripheric in apice hypharum per stomata fasciculatum erumpentum ortis, hyalinis, valde curvatis, episporio crasso, 33–51 x 7.8–9.2 μ.

Telia hypophyllous, subgregarious or scattered, roundish, pulvinate, 0.17–0.25 mm. in diameter, subepidermal, whitish, erumpent through stoma, with incurved, hyaline, thick-walled paraphyses at the periphery; teliospores and paraphyses formed superficially at the apex of a single or usually a bundle of sporogenous hyphae; *teliospores* ovoid or ellipsoid, thin-walled (less than 1 μ thick), hyaline, usually slightly attenuated at apex or rounded at both ends, 26–41 x 11–16 μ, germinating *in situ* by prolongation of the apex of the spore, forming a cylindrical 4-celled promycelium; *pedicel* short (up to 8.6 μ long), fragile, hyaline; *paraphyses* cylindrical, hyaline, strongly incurved, thick-walled, 33–51 x 7.8–9.2 μ.

This interesting rust fungus is similar to *Gerwasia Rubi* in the manner of forming teliospores, but differs in the bundle of stalk cells, instead of one or two as in *G. Rubi,* and in the presence of the peripheral paraphyses. The genus *Gerwasia* was established in 1909 by Raciborski on *G. Rubi* from Java. A second species, *G. fasciculata* also on *Rubus* sp., was recently described by Arthur and Cummins (Philippine Jour. Sci. **61**: 466. *pl. 2 fig. 1.* 1936) from the Philippines. The Philippine species also has incurved peripheral paraphyses.

The teliospore of the Hunan fungus is pedicellate, arising from the apex of a stalk cell, 2 or 4 in number. New spores may be produced laterally and successively right below the old spore. Sometimes the stalk cell fails to produce spores at its apex, but gives rise again to a bundle of sporogenous hyphae. The spores germinate *in situ* at once on maturity. In measuring the teliospores they have to be crushed out under the cover glass. The mature spores become emptied and shrunken after germination, only a few of those which are just beginning to germinate being normal in shape and size. The rest are young spores. In one of the many sections of the telium studied by the writer only a single stalk cell was found, bearing at its apex paraphyses and teliospores. The stalk cells, however, usually are grouped in a bundle.

In two of the mountings, uredospores and teliospores of a *Phragmidium* were present. A subsequent search was made for the uredia and telia on the

specimens, but without result. The uredospores are subglobose or ellipsoid, verruculose, hyaline, and measure 20–26 x 16–20 μ (epispore 1.5–2 μ thick). The teliospores are cylindrical, 4–6 (rarely only 2) septate, rounded at both ends, chestnut brown and measure 60–103 (including the apiculum 7–11 μ long) x 29–34 μ; pedicel up to 103 μ long, 13–19 μ broad and asperulate below. This fungus fits well with the description of *Phragmidium mucronatum* to which it is referred.

HEMILEIA Berk. et Br.

Hemileia vastatrix Berk. et Br.

On *Coffea arabica*. **Yunnan**: Hokow, *4368*.

TRANZSCHELIA Arth.

Tranzschelia suffusca (Holw.) Arth.

On *Pulsatilla cernua*. **Szechuan**: Chengtu, *6860*.

Tranzschelia Pruni-spinosae (Pers.) Diet.

On *Prunus persica*. **Yunnan**: Chengkung, *4412*; Kaiyuan, *4532*.

HAMASPORA Koernicke

Hamaspora sinica Tai et Cheo

On *Rubus Parkeri*. **Kweichow**: Meitan, *7933*. On *R.* sp. **Hunan**: Hwanhsien, *5054*; **Szechuan**: Penghsien, *8047*. On *R. phenicolasius*. **Hunan**: Hengshan, *4740*, *4744*, *4741*, *4743*; Yolushan, Changsha, *4714*, *4739*.

Hamaspora benguetensis Syd.

On *Rubus ellipticus* var. *obcordatus*. **Yunnan**: Kweishan, Nangkiao, *6627*.

Uredia hypophyllous, more or less gregarious, confluent, roundish, 0.35–0.5 mm. in diameter, pulverulent, cinnamon brown; *uredospores* globose, subglobose or ovate, echinulate, pale cinnamon brown epispore 1.5–2 μ thick, 17–23 x 15–18 μ; *paraphyses* numerous, cylindrical or clavate, pale cinnamon brown often sharply pointed at apex, strongly curved, 43–51 x 8–11 μ.

PHRAGMIDIUM Link

Phragmidium pauciloculare (Diet.) Syd.

On *Rubus parvifolius*. **Yunnan**: Kunming, *6981*; Shihling, Lunan, *7652*; **Hunan**: Hwanhsien, *5056*. On *R. rosaefolius*. **Hunan**: Hengshan, *4578*, *4736*. On *R.* sp. **Szechuan**: Shehung, *7612*. On *R. subornatus*. **Yunnan**: Hwaling, *7683*.

Phragmidium Rubi-parvifolii Liou and Wang is no doubt identical with the present species.

Phragmidium brevipedicellatum Hiratsuka f.

On *Potentilla Kleiniana*. **Yunnan**: Kunming, *8014*; Sungming, *4796*.

Uredia amphigenous, chiefly hypophyllous or on petioles, densely gregarious, often in circular groups to scattered, "orange chrome" in color, naked, 0.25–1 mm. in diameter, pulverulent, roundish or elliptic, oblong on petioles; *uredospores* subglobose, globose, ellipsoid or piriform, finely echinulate, epispore 1–1.5 μ thick, hyaline, contents orange yellow and granular when fresh, 17–24 x 13–21 μ; *paraphyses* numerous, cylindrical-clavate, straight or more or less curved, thin-walled, hyaline, 63–84 μ long, 7–8 μ wide (up to 11 μ) at the broadest part; *pores* indistinct. *Telia* hypophyllous, scattered, pulvinate, roundish, about 0.5 mm. in diameter, black; *teliospores* cylindrical, 2–4 septate, mostly 3–4, rarely 2, not or slightly constricted at septum, epispore 2–2.5 μ thick, smooth, dark chestnut brown, uniform in thickness, sometimes thicker at the apex (up to 4 μ), rounded at both ends, non-papillate at apex, 40–63 x 21–24 μ, 3 germ *pores* in each cell; *pedicel* short, hyaline, non-hygrophorous, 17–49 μ long, 7–9 μ wide, tapering below.

The teliospores of the Yunnan forms are smaller than those given in the original diagnosis ("42–93 x 21–30 μ").

Phragmidium mucronatum (Fr.) Schl.

On *Rosa odorata*. **Yunnan**: Kunming, *7566*, *6873*, *7565*, *7571*. On *R.* sp. **Kansu**: Langchow, *8387*.

The length of the teliospore is variable: usually the spore measures 60–110 μ in length, but sometimes up to 144 μ long on the same host collected in the same locality. The septation varies from 3 to 7, commonly 4–5, rarely 3 or 7.

Phragmidium Rosae-rugosae Kasai

On *Rosa omeiensis*. **Yunnan**: Chichushan, Pinchuan, *4370*, *4765*. On *R.* sp. **Kweichow**: Tsechoa, *8442*.

The aecial stage reported in Japan has not been collected. The brown or chestnut brown color of the telia and the golden brown teliospores distinguish the species. The septation of the teliospores of the Yunnan plant is 4 to 7, commonly 6, rarely 2 or 3, while that of the Japanese plant is 5–10, generally 7.

NYSSOPSORA Arthur

Nyssopsora Cedrelae (Hori) Diet.

On *Spondias axillaris*. **Hunan**: Yolushan, Changsha, *4480*, *4724*, *4731*, *4749*.

Telia amphigenous, chiefly hypophyllous, if epiphyllous always along the middle main vein, roundish, 1–1.5 mm. in diameter, pulverulent, black; *teliospores* subglobose, polygono-globose or piriform, the lower cell usually compressed, 30–37 μ long, 23–34 μ broad, not or slightly constricted at septum, brownish black, opaque, processes 14–27 in number, 2–3 branched at apex, olivaceous brown, 6–9 μ long, 2–3 μ broad; *pedicel* hyaline, 63–90 x 7–9 μ, minutely asperulate.

PILEOLARIA Castagne

Pileolaria Terenbinthi (DC.) Cast.

On *Pistacia weinmannifolia*. **Yunnan**: Hualing, *4452*; Kaiyuan, *5073*.

Pileolaria Shiraiana (Diet. et Syd.) Ito

On *Rhus Delavayi* var. *quinquejuga*. **Yunnan**: Kunming, *7004*.

The Kunming form has larger teliospores (24–41 μ high, 36–46 μ wide against "18–36 μ high, 25–37 μ" wide (Ito)) and longer pedicels (30–52 μ long against "35 μ" (Ito)).

RAVENELIA Berk.

Ravenelia Indigoferae-scabridae sp. nov.

On *Indigofera scabrida*. **Yunnan**: Shishan, Kunming, December 1938, *F. L. Tai, 4632*, **type!** *4446, 4447, 5043, 7790, 7792, 7794*; Kütsing, *7791*; Hsiakwan, Tali, *4643, 7793*.

Urediis hypophyllis, sparsis vel aggregatis, rotundatis, 0.5–1 mm. diam., pulverulentis, "Hazel brown" (Ridgway); *uredosporis* subglobosis, obovoideis vel ellipsoideis, dense echinulatis, episporio 1.5-2 μ crasso, hyalino vel subhyalino, 20–27 x 17–24 μ; *poris germ.* 8, sparsis instructis; *paraphysibus* capitatis, superne flavidis vel brunneolis, deorsum pallidioribus, 6–83 μ longis, apice, 21–30 μ crassis.

Teliis amphigenis, plerumque hypophyllis, minutis, 0.5–1 mm. diam., epidermide rupta cinctis, aggregatis, plerumque circinatim dispositis, confluentibus, pulverulentis, atris; *capitulis teliosporarum* hemisphaericis, 83–131–(144) μ diam., castaneo-brunneis, levibus, e sporis 5–8 in omni directione compositis, sporis singulis unicellularibus, 26–37 μ altis, 16–18 μ latis, *episporio* ad apicem 6–9 μ crasso; *cystidiis* capitulo adpressis, tam numerosis quam sporae singulae; pedicello hyalino, brevi.

Ravenelia macrocapitula sp. nov.

On *Indigofera Hancockii*. **Yunnan**: Chichushan, Pinchuan, Sept. 16, 1938, *H. S. Yao, 7787*, **type!** *Changshan, Tali 7786*. On *Indigofera Dielsiana*. **Yunnan**: Changshan, Tali, *5042*.

Urediis hypophyllis, sparsis vel aggregatis, 0.5–0.8 mm. diam., confluentibus, pulverulentis, "Sanford's brown" (Ridgway); *uredosporis* globosis vel late ovatis, pallide flavidis vel subhyalinis, remoteque verruculosis, 21–26 x 21–23 μ, episporio 1.5–2 μ crasso, *poris germinativis* 6 sparsis instructis; *paraphysibus* numerosis, spathulatis vel capitatis, 63–86 μ longis, apice flavis vel flavo-brunneis, 20–26 μ latis, deorsum hyalinis, asperulatis.

Teliis amphigenis, sparsis vel dense aggregatis, subepidermicis, 1–1.5 mm. diam., atro-brunneis; *capitulis teliosporarum* leniter convexis, 99–142 μ diam., castaneo-brunneis, ex sporis 6–9 in omni directione compositis, sporis omnibus papillis 4–8 rectis vel subinde curvulis hyalinis usque 4 μ longis, ca. 1.5 μ latis obsitis; sporis singulis bicellularibus, 40–49 μ altis, 16–21 μ latis, episporio ad apicem 6–9 μ crasso; *cystidiis* tam numerosis quam sporae singulae, capitulo adpressis; pedicello hyalino, brevi.

This species is distinct from *R. Indigoferae* in the larger telio-heads and slightly smaller uredospores and from *R. Schroeteriana* in the slightly larger uredospores and larger telio-heads.

Ravenelia laevis Diet. et Holway

On *Indigofera cinerascens*. **Yunnan**: Kunming, *6978, 7788, 7789*. On *I.* sp. **Yunnan**: Kunming, *5040*.

R. Mitteri Syd. seems to differ from *R. laevis* only in the smaller uredospores and somewhat smaller telio-heads.

Ravenelia japonica Diet. et Syd.

On *Albizzia kalkora*. **Hunan**: Yolushan, Changsha, *4487*, *4682*, *4712*, *4725*. On *A. julibrissin*. **Szechuan**: Chengtu, *6824*.

GYMNOSPORANGIUM Hedw. f.

Gymnosporangium clavariaeforme (Jacq.) DC.

On *Craetagus scabrifolius*. **Yunnan**: Lutien, *4537*; Tungchuan, *4591*.

Gymnosporangium Haraeanum Syd.

On *Pyrus* sp. **Yunnan**: Süanwei, *4872;* Lutien, *4820*. On *Chaenomeles sinensis*. **Yunnan**: Süanwei, *4871*.

Gymnosporangium Cunninghamianum Barcl.

FIGURE 8

On *Cupressus Duclouxiana*. **Yunnan**: Kunming, *8097*, *8162*, *8197*.

Telia on green and woody twigs, sorus-bearing part of the woody twig slightly enlarged, 1.5–6.5 cm. long, 0.5–10 mm. wide, in rows on woody twigs, solitary on green twigs, hemispheric, loaf- or tongue-shaped, 1.5–3 mm. in diam., 1.5–4 mm. high (hemispheric), 4 mm. long, 2–3 mm. high (oblong), "carob brown"; *teliospores* ellipsoid or ellipsoid-oblong, rounded or usually acute at both ends, epispore of thin-walled spores 2–3 μ thick, cinnamon brown, thick-walled, 3–4 μ thick, chestnut brown, smooth, contents granular, not or slightly constricted at septum, thin-walled spores measuring 53–67 x 24–30 μ, thick-walled 57–63 x 29–36 μ (broadly ellipsoid); *pores* 4–6 in each cell in a transverse zone near the septum or in two zones, those near the apex in the upper cell, and near the base in the lower cell being only one or two in number; *pedicel* long and slender up to 435 μ long.

The teliospores of this species are said to have 1 or 2 pores near the septum, but those of the Yunnan fungus as described above have 4–6 pores in a transverse zone or in two zones.

Gymnosporangium japonicum Syd.

On *Photinia villosa*. **Hunan**: Yolushan, Changsha, *4709*, *4684*.

Gymnosporangium juniperinum (L.) Mart.

On *Sorbus Valbrayi*. **Yunnan**: Changshan, Tali, *4362*.

Gymnosporangium nipponicum Yamada

On *Sorbus alnifolia*. **Kweichow**: Kiangkowhsien (Fang Ching Shan), *S. Y. Cheo 503*.

Pycnia epiphyllous. *Aecia* gregarious in groups 6–7 mm. wide, on swollen parts, cylindrical, 1.5–2 mm. long, 0.2–0.3 mm. wide, brownish yellow, lacerate at apex; *aeciospores* subglobose, globose or rarely broadly ovate,

epispore 2–3 μ thick, yellow or ochraceous yellow, minutely and densely verrucose, 24–31 x 21–26 μ; *peridial cells* rhomboid in face view, 49–86 x 26–47 μ, inner wall 5–18 μ thick, verruculose with papillae, outer wall smooth, 3–4 μ thick; *pores* 6–8 scattered.

The present collection was determined by Dr. I. H. Crowell as *G. Miyabei* Yamada et Miyake. It seems to the writer that the aeciospores of this collection are too large for that species (24–31 x 21–26 μ against "18–24 x 18–22 μ" of *G. Miyabei*) and are also thicker-walled (2–3 against "1–1.5" of *G. Miyabei*). It is very close to *G. nipponicum*.

Gymnosporangium wenshanense sp. nov.

On *Photinia serrulata*. **Yunnan**: Matan, Wenshan, Aug. 15, 1938, *T. H. Wang & S. T. Chao, 4363*, **type!**

Pycniis gregariis, epiphyllis, 0.2–0.25 mm. diam. *Aeciis* amphigenis, plerumque hypophyllis, maculis decoloratis incrassatulis insidentibus, in greges rotundatos 1.5–5 mm. latos dense vel annulatim dispositis, cupulatis, 0.3–0.5 mm. diam., margine lacerato; *cellulis peridii* rhomboideis, 21–34 x 21–29 μ, pariete interiore 4–5 μ crasso, minute verrucoso, exteriore levi 7–10 μ crasso; *sporis* angulato-globosis vel subglobosis, dense et minute verruculosis, *episporio* 2–3 μ crasso, hyalino, 23–30 x 18–23 μ; *teliosporis* adhuc ignotis.

The present collection differs from *Aecidium Pourthieae* Syd. in the larger and thicker-walled aeciospores and larger peridial cells. It is also distinct from *Gymnosporangium japonicum* in the cupulate aecia and other characters.

MAINSIA Jackson

Mainsia chinensis (Diet.) Jackson

On *Rubus Swinhoei* var. *hupehensis*. **Szechuan**: Kwanhsien, *8427*. On *R. setchuenensis*. **Szechuan**: Kwanhsien, *8428*. On *R.* sp. **Hunan**: Hengshan, *4737*.

UROMYCES Unger

Uromyces Alopecuri Seym.

On *Alopecurus pratensis*. **Yunnan**: Kunming, *7217, 5026*.

Uromyces coronatus Miyabe et Nishida

On *Zizania latifolia*. **Szechuan**: Chengtu, *6825*.

Uromyces tenuicutis McAlpine

On *Sporobolus indicus*. **Yunnan**: Kunming, *2914*; **Szechuan**: Chengtu, *7543a*.

Uredia amphigenous, chiefly epiphyllous, gregarious or scattered, elliptic or oblong, covered by epidermis, then ruptured by a longitudinal slit, 1–1.5 mm. long, 0.2–0.3 mm. wide, pulverulent, cinnamon brown; *uredospores* ellipsoid, globoid or broadly ovate, sparingly echinulate, pale cinnamon brown, epispore about 1.5 μ thick, 27–36 x 20–24 μ; *pores* 4–5 equatorial.

Uromyces inaequalitus Lasch.

On *Stellaria sexatilis*. **Yunnan**: Kunming, *4411, 7650*.

Uromyces MacIntirianus Barcl.

On *Hemigraphis* sp. **Yunnan**: Kaiyuan, *4810*.

Telia hypophyllous, densely gregarious in orbicular groups (2–5 mm. in diam.), confluent, 0.25–0.35 mm. in diameter, at first covered by epidermis, finally erumpent, compact, blackish brown; *teliospores* ovate, ovate-oblong, clavate or subglobose, rounded or angular at apex, slightly thickened at apex (3–4 μ), attenuated below, epispore about 2 μ thick, cinnamon brown, smooth, 20–36 x 16–24 μ; *pedicel* persistent, long, up to 64 μ long, hyaline or tinted; few 2-celled *spores* (about 2%) present, ellipsoid or rarely clavate, epispore 2–3 μ thick, apex slightly thickened (3–4 μ), cinnamon brown, smooth, not or slightly constricted at septum, 31–49 x 20–23 μ, rounded at apex, usually slightly attenuated at the base, pore of the upper cell apical, that of the lower at the septum; *pedicel* persistent and long.

Uromyces Sophorae-viciifoliae sp. nov.

FIGURE 18

On *Sophora viciifolia*. **Yunnan**: Lunan, December 26, 1938, *T. F. Yu, S. T. Chao & T. H. Wang, 4415*, **type!** Kunming *5277*; Tachwang, *4767*.

Uredíis amphigenis, sparsis vel subgregariis, confluentibus, bullatis, epidermide fissa cinctis, rotundatis, 0.5–1 mm. diam., pulverulentis, cinnamomeo-brunneis; *uredosporis* subglobosis, ellipsoideis vel oblongis, echinulatis, 23–30 x 16–20 μ, episporio 1–1.5 μ crasso, pallide cinnamomeo-brunneo; *poris germinativis* 4 aequatorialibus instructis.

Teliis conformibus, pulverulentis, atrobrunneis; *teliosporis* ellipsoideis vel cylindraceis, rarius subglobosis, apice rotundatis vel attenuatis, leniter incrassatis (3–6 μ), basi rotundatis vel plerumque attenuatis, castaneo-brunneis, levibus, 24–47 x 14–19 μ, episporio 1.5–2 μ crasso; *pedicello* hyalino, brevi.

Uromyces decoratus Syd.

On *Crotalaria lonchophylla*. **Yunnan**: Hsiakwan, Tali, *4644*.

Uromyces striatus Schroet.

On *Trifolium repens*. **Yunnan**: Kunming *5049*; Sungming, *4423*.

Uromyces punctatus Schroet.

On *Astragalus sinicus*. **Yunnan**: Panchi, *7682*.

Uromyces Lespedezae-procumbentis (Schw.) Curt.

On *Lespedeza juncea*. **Yunnan**: Kunming, *6974*. On *L. bicolor*. **Hunan**: Hengshan, *4486, 4723*. On *Kummerovia striata*. **Hunan**: Yolushan, Changsha, *4483*.

Dr. Naohide Hiratsuka has separated the form on *Kummerovia striata* as a distinct species: *U. Itoanus*. After a careful study of the forms on *Kummerovia* and *Lespedeza* by the writer, no appreciable difference has been found to distinguish them as distinct species.

Uromyces rugulosus Pat.

FIGURE 24

On *Campylotropis polyantha*. **Yunnan**: Kunming, *4534*, *5052*, *7200*, *7601*; Chengkung, *7527*; Kütsing, *7798*. On *C. Balfouriana*. **Yunnan**: Kunming, *5075*, *5077*, *7199*. On *C. hirtella*. **Yunnan**: Kunming, *4530*, *7198*, *7232*, *7602*.

Uredia amphigenous, scattered or subgregarious, roundish, 0.3–0.5 mm. in diameter, pulverulent, cinnamon brown; *uredospores* subglobose or ovate, echinulate, epispore 1.5–2 μ thick, yellowish or subhyaline, 18–29 x 14–21 μ; *paraphyses* numerous, cylindrical, thick-walled, straight or curved, up to 86 μ long, 7–8.5 μ wide, golden yellow or subhyaline. *Telia* amphigenous, mostly hypophyllous, scattered or subgregarious, sometimes confluent, covering the entire leaf surface, roundish or irregular in shape, 0.3–0.5 mm. in diameter, pulverulent, blackish brown; *teliospores* subglobose, ovate or oblong, rounded at apex which is provided with a flattened cinnamon brown papilla (1–3 μ high), base rounded or slightly attenuated, epispore 2.5–3.5 μ thick, verrucose, chestnut brown, 21–36–(41) x 16–23 μ; *pedicel* hyaline, as long as the spore.

The teliospores of the form on *Campylotropis polyantha* are slightly smaller than those on other species of *Campylotropis*. *Uromyces rugulosus* was described from Yunnan by Patouillard in 1888 (Jour. de Bot. **2**: 151. 1888), only the telial stage being known. Liou and Wang's *Uromyces Lespedezae-macrocarpae* (Contr. Inst. Bot. Nat. Acad. Peiping **3**:30. 1935) is evidently identical with the former. They also described only the telial stage.

Uromyces Phaseoli typica Arth.

On *Phaseolus vulgaris*. **Yunnan**: Kunming, *4401*; Tali *4404*; Kaiyuan, *5162*; Chengkung, *4822*.

Uromyces Phaseoli Vignae Arthur

On *Vigna sinensis*. **Yunnan**: Kunming, *4832*; Pinchuan, *4863*; Kaiyuan, *4834*, *4835*; Hualing, *4830*, *4831*; I-Liang, *5182*.

Uromyces Ervi (Wallr.) West

On *Vicia tetrasperma*. **Yunnan**: Kunming, *7395*.

Uromyces Kondoi Miura

FIGURE 25

On *Gueldenstaedtia Delavayi*. **Yunnan**: Lungtan, Süanwei, *8487*.

Uredia amphigenous, scattered or gregarious, roundish, naked, surrounded by ruptured epidermis, sometimes confluent, 0.3–1 mm. in diameter, pulverulent, cinnamon brown; *uredospores* globose, finely echinulate, pale cinnamon brown, epispore 2–3 μ thick, 20–23 μ in diameter; *pores* 4 scattered. *Telia* amphigenous, mainly hypophyllous, naked, roundish, 0.3–1 mm. in diameter, compact, chestnut brown; *teliospores* ovate or sub-

globose, densely verruculose, epispore 2–3 μ thick, chestnut brown, with a small flat or hemispheric yellowish papilla at apex, 23–28 x 16–21 μ; *pedicel* short, hyaline, fragile.

Uromyces Gueldenstaedtiae Liou et Wang was evidently published without the knowledge of Miura's species. In the original diagnosis of both *U. Kondoi* and *U. Gueldenstaedtiae* only the telial stage was reported. This species is close to *U. Genistae-tinctoriae*, but differs in the globose uredospores with 4 scattered pores and the slightly larger, thicker-walled and darker-colored teliospores which are never verrucose in striae.

Uromyces Fabae (Pers.) DeBary

On *Vicia sativa*. **Yunnan**: Chengkung, *7250*. On *V. Faba*. **Yunnan**: Kunming, *4425*, *5978*; I-Liang, *4853*; Kaiyuan, *5170*; Tachwang, *5165*.

Uromyces Geranii (DC.) Fries

On *Geranium nepalense*. **Yunnan**: Kunming, *7649a*.

Uromyces bidenticola (P. Henn.) Arth.

On *Bidens pilosa*. **Yunnan**: Shihling, Lunan, *7651*.

Uredia amphigenous, or caulicolous and on petioles, gregarious or scattered, roundish, surrounded by ruptured epidermis, 0.5–1 mm. in diameter, pulverulent, chestnut brown; *uredospores* subglobose, ovoid or ellipsoid, echinulate, epispore 2–3 μ thick, yellowish, 27-38-(44) x 20-29 μ; *pores* 2 approximately equatorial.

Uromyces Polygoni (Pers.) Fckl.

On *Polygonum aviculare*. **Yunnan**: Hsiakwan, Tali, *5006*; **Szechuan**: Lanchung, *6826*.

PUCCINIA Pers.

ON GRAMINEAE

Puccinia Sorghi Schw.

On *Zea Mays*. **Yunnan**: Kunming, *7945*; Chengkiang, *4385*; Kaiyuan, *4824*; **Kansu**: Hweihsien, *8411*.

Puccinia Eulaliae Barcl.

On *Erianthus fastigiatus*. **Yunnan**: Kunming, *7617*. On *Miscanthus sinensis*. **Fukien**: Yungan, *7500*. On *M. japonicus*. **Hunan**: Hengshan, *4669*; Yolushan, Changsha, *4685*. On *Miscanthus* sp. **Hunan**: Hengshan, *4688;* Yolushan, Changsha, *4763*. On *Saccharum* sp. **Kiangsu**: Chinkiang, *8376*. On *Sorghum vulgare*. **Kiangsu**: Nanking, *7620*.

Re-examination of the rust on *Erianthus fulvus* collected by the writer at Nanking in 1928 and identified by Mr. H. Sydow as *Puccinia purpurea* (Ann. Mycol. **27**: 419. 1929) shows that it is also this species.

Puccinia Eulaliae according to the description differs from *P. Miscanthi* Miura in the shorter and narrower teliospores and the ovate-piriform uredospores. In the original diagnoses of these two species, however, uredospores

were described in both cases only from those intermixed with teliospores. And in the case of *P. Eulaliae* the number and position of the germ-pores of the uredospores were not given. The writer in the course of studying rust collections from different parts of China found forms agreeing closely with *P. Eulaliae* except that the teliospores are larger (30–57 x 14–24 μ). The uredospores of these forms have 4–5 equatorial pores. *P. Miscanthi* is certainly distinct in its globose and verrucose uredospores with 10 scattered pores. Teng (Sinensia **8**:256. 1937) considered *P. Miscanthi* as a synonym of *P. Eulaliae*. The question of whether or not these are identical could be settled only by a comparative study of the type specimens of these two species.

On account of the large size of the teliospore of the Chinese form, they are often referred to *P. Miscanthi* in this country. Thus, the present writer erroneously referred in a previous publication (Nanking Jour. **2**: 175. 1932) a *Puccinia* on *Miscanthus sinensis* to the latter species. It should be identified as *P. Eulaliae*.

Puccinia erythropus Diet.

On *Miscanthus japonicus*. **Hunan**: Hengshan, *4492*, *4657*, *4665*, *4683*; **Szechuan**: Chengtu, *7546*.

P. erythropus differs from *P. Eulaliae* macroscopically in the larger telia, ellipsoid or ellipsoid-oblong teliospores and thicker-walled smaller uredospores which are sometimes thickened at their apex.

Puccinia Pollinae-quadrinervis Diet.

On *Eulalia quadrinervis*. **Yunnan**: Kunming, *5028*, *7231*. On *Eulalia*, sp. **Yunnan**: Panchi, *7674*.

Puccinia Kühnii (Krug.) Butler

FIGURE 9

On *Saccharum spontaneum*. **Yunnan**: Kunming, *8291*, *8377*.

Uredia hypophyllous, also on leaf sheath, oblong or linear, scattered or usually seriate, 0.5–2.5 mm. long, 0.2–0.5 mm. wide, at first covered by epidermis, finally ruptured by a longitudinal slit, usually at the sides, orange yellow when fresh, pulverulent; *uredospore* subglobose, ellipsoid or piriform with orange contents, echinulate, epispore 1.5–2 μ thick, subhyaline or yellowish, 27–39 x 17–24 μ; *pores* 4 equatorial. *Telia* hypophyllous, roundish, elliptic, oblong or linear, scattered or seriate, 0.35–2 mm. long, 0.2–0.8 mm. wide, pulvinate, brownish black; *teliospores* ellipsoid or occasionally subglobose, broadly ovate or oblong, rounded at both ends, rarely truncate or obtusely acuminate at the apex, pore of the upper cell apical or slightly depressed, of the lower, at the septum, apex thickened (4–7 μ), 1.5–2 μ thick at sides, smooth, not constricted at septum, cinnamon brown, 36–56 x 14–21 μ; *pedicel* brownish, 3 times as long as the spore or longer (up to 139 μ long), often laterally attached; *paraphyses* clavate or cylindrical, brownish or hyaline, 43–77 μ long, the apical part 10–18 μ wide, walls of the apex 3–6 μ thick, 1.5–2 μ thick at sides below.

The collections above listed are referred to *Puccinia Kühnii* with some hesitation, as the uredospores of the present fungus are smaller and the teliospores much larger, borne on long pedicels, than those of *P. Kühnii*. Also the uredospores are not thickened at apex. A comparison has been made of the present fungus with one on *Saccharum arundinaceum* collected by the writer at Nanking in 1928 (Univ. Nanking Path. Herb. no. 2802) and identified by Mr. Sydow as *P. Kühnii*. The latter form has larger uredospores (26–46 x 18–31 μ), some of which have a thickened apex.

Teng and Ou's *Puccinia Kühnii* (Sinensia 8:259. 1937) on *Saccharum narenga* is apparently *P. Eulaliae*.

Puccinia filipodia Cummins

On *Heteropogon contortus*. **Yunnan**: Kunming, *4422*, *7658*; **Szechuan**: Shehung, *7613*.

Uredia amphigenous, chiefly epiphyllous, elliptic or linear, gregarious or scattered, 0.5–0.6 mm. long, at first covered by epidermis, finally ruptured by a longitudinal slit, ferruginous, pulverulent; *uredospores* globose, subglobose, broadly ellipsoid or ovate, epispore 2–3 μ thick, cinnamon brown, finely echinulate, 24–34 x 26–30 μ; *pores* 6–11, scattered.

Puccinia Cesatii Schroet.

On *Andropogon annulatus*. **Yunnan**: Paosi, *4814*; Lunan, *5031*; **Szechuan**: Chengtu, *4426*.

Puccinia erythraeensis Pazschze

On *Andropogon micranthus*. **Yunnan**: Kunming, *5029*, *5030*, *7623*; Paosi, *5076*; **Hunan**: Hengshan, *4674*, *4700*, *5038*; **Szechuan**: Chengtu, *7555*.

The fungus of the collections above listed has larger teliospores (31–39 x 23–32 μ) than those of *Puccinia Andropogonis-micranthi* Diet., and the teliospores are often slightly thickened (4–6 μ) at the apex. It agrees rather closely with *P. erythraeensis* which differs from *P. Andropogonis-micranthi* mainly in the slightly larger size and slightly thickened apex of the teliospore. The latter may be synonymous with the former.

Puccinia Duthiae Ell. et Tracy

On *Andropogon* sp. **Yunnan**: Mengtze, *5036*.

Uredia amphigenous, mainly hypophyllous, scattered or densely gregarious in orbicular or oblong groups, roundish or oblong, 0.5–1 mm. long, chestnut brown; *uredospores* globose, subglobose, or rarely ovoid, echinulate, pale chestnut brown, epispore 1.5–3.5 μ thick; *pores* 5–6 equatorial, 26–36 x 20–26 μ. *Telia* similar, confluent, pulvinate, black; *teliospores* ovate, broadly ellipsoid or oblong, rounded at both ends, rarely cuneate at apex, or slightly attenuated at the base, apex thickened (up to 6 μ thick) 3–4 μ thick at sides, dark chestnut brown, not or slightly constricted at septum, smooth, 33–53 x (17)–21–30 μ; *pedicel* persistent, brownish, up to

108 μ long, often laterally attached; *mesospores* present; *paraphyses* copious, capitate, yellow or yellowish brown.

The uredial stage of *P. erythraeensis* is often confused with that of this species. The uredospores of *P. Duthiae* are slightly larger, thicker-walled, and darker-colored than those of the former.

Puccinia Polliniae Barcl.

On *Strobilanthes dryadum*, O & I. **Yunnan**: Chichushan Pinchuan, *4329*. On *Microstegium* (*Eulalia*) *vimineum* ? II. **Yunnan**: Kunming, *3034*.

Puccinia Arundinellae-setosae sp. nov.

FIGURE 6

On *Arundinella setosa*. **Yunnan**: Kunming, November 1939, *F. L. Tai, 4813*, **type!** *7575, 7611*. On *Sporobolus indicus*. **Szechuan**: Chengtu, *7543*.

Uredïs amphigenis, rotundatis vel oblongis, seriatim dispositis, numerosis, 0.35–1 mm. longis, pulverulentis, fuscis; *uredosporis* ellipsoideis, late ovatis vel subglobosis, echinulatis, 21–30 x 18–21 μ, castaneo-brunneis, episporio 2–2.5 μ crasso, *poris germinativis* 3–5 acquatorialibus praeditis; *paraphysibus* numerosis, capitatis vel clavatis, brunneolis vel castaneis.

Teliis conformibus, pulvinatis, atris; *teliosporis* ellipsoideis vel ovato-oblongis, apice leniter incrassatis (2–4 μ), rotundatis, basi plerumque attenuatis vel rotundatis, castaneis, levibus, medio non vel leniter constrictis, saepe oblique vel verticaliter septatis, 30–43 x 16–21 μ, episporio 1.5 μ crasso; *pedicello* brevi, castaneo, subinde lateraliter inserto, *mesosporis* immixtis.

This rust fungus differs from all the other species of *Puccinia* on *Arundinella* by the smaller teliospores with short pedicel and the paraphysate uredia.

Puccinia Arundinellae-anomalae Diet.

On *Arundinella anomala*. **Hunan**: Yolushan, Changsha, *4760, 4583, 4582, 4517*; Hengshan, *4493, 4581, 4752, 4726*; Hwanhsien, *5032*.

Puccinia Arundinellae Barcl.

On *Arundinella setosa*. **Yunnan**: Kunming, *7593a, 7576, 7609*. On *A. nepalensis*. **Yunnan**: Kunming, *7916*. On *A.* sp. **Yunnan**: Tali, *7082*.

Uredia amphigenous, oblong or linear, seriate, long covered by epidermis, later opened by a longitudinal slit, 0.5–1.5 mm. long, pulverulent, orange yellow; *uredospores* subglobose, ovoid or ellipsoid, epispore 1.5–2 μ thick, verrucose-echinulate, 24–33 x 20–24 μ; *pores* obscure. *Telia* amphigenous, mainly hypophyllous, also on the sheath, at first covered by epidermis, finally naked, elliptic, seriate, 0.5–1.5 mm. long, 0.35–0.5 mm. broad, pulvinate, brownish black to black; *teliospores* various in shape, ellipsoid, ovate-oblong, oblong rarely subglobose, sometimes clavate, rounded at both ends, sometimes tapering either towards the apex or towards the base, rarely truncate at apex, thickened at apex (4–9 μ), 2–3 μ thick at sides, not or slightly constricted at the septum, epispore chestnut brown, smooth, pore of the upper cell apical or slightly depressed, that of the lower at the septum,

37–56 x 21–29 μ; *pedicel* persistent, yellowish, up to 3 times as long as the spore, occasionally obliquely attached; *mesospores* present.

The telial stage agrees well with the description of *Puccinia Arundinellae* as given by the Sydows in their Monographia Uredinearum (**1**:732. 1904) in which the uredial stage was not mentioned. A short description of that stage was, however, published in 1907 by the Sydows and Butler (Ann. Mycol. **5**:499. 1907). Uredia were found associated with the telial stage in the Yunnan collections nos. *7576* and *7609*. The characters of the two sori are similar except that the telia are pulvinate and brownish-black or black, while the uredia are pulverulent and orange yellow in color. Uredospores have also been found intermixed with teliospores in the telia. The uredospores as found by the present writer are different from those described by the previous authors. They are larger, with hyaline walls and orange-yellow contents. The *Uredo* attributed to *P. Arundinellae* by the Sydows and Butler may belong to some other species of *Puccinia*, the telial stage of which is yet to be discovered.

Puccinia levis (Sacc. et Bizz.) Magnus

On *Digitaria sanguinalis*. **Yunnan**: Kaiyuan, *4764*; **Szechuan**: Chengtu, *4431*.

Puccinia polysora Underw.

On *Setaria Forbesiana*. **Yunnan**: Kunming, *7535*, *7631*.

Puccinia sinica Syd.

On *Muehlenbergia Huegelii*. **Kiangsu**: Nanking, Univ. Nanking Path. Herb. no. *2254*.

Puccinia sinica was published in 1929 (Ann. Mycol. **26**:419. 1929) by H. Sydow. In the original diagnosis the uredial stage was not mentioned. It has been found by the writer on the co-type collection: *Uredia* amphigenous, mainly hypophyllous, scattered or seriate, numerous, elliptic or oblong, 0.35–0.5 mm. long, at first covered by epidermis, at length ruptured by a longitudinal slit, pulverulent, yellowish; *uredospores* subglobose, globose or ovate, epispore about 1.5 μ thick, finely echinulate, hyaline. 14–19 x 12–13 μ; *pores* obscure.

Puccinia Cynodontis Desm.

On *Cynodon dactylon*. **Yunnan**: Kunming, *8384*.

Puccinia agrostidicola sp. nov.

FIGURE 4

On *Agrostis* sp. **Kansu**: Yungdun, Aug. 23, 1943, *W. L. Hsian*, *8404*, **type!**

Urediis hypophyllis, saepe etiam in vaginis culmisque evolutis, elongatis vel linearibus 0.5–1.5 mm. longis, sparsis, epidermide fissa cinctis, pulverulentis, flavo-brunneis; *uredosporis* globosis vel rarius ovoideis, subtiliter echinulatis, 24–33 x 23–30 μ, episporio 1.5–2 μ crasso, flavidis, *poris germinativis* 8–10 sparsis. *Teliis* urediis conformibus, pulvinatis, atris; *teliosporis* ellipsoideis vel ellipsoideo-oblongis, apice conico-attenuatis

vel rarius rotundatis, valde incrassatis (8.5–11 μ), medio leniter constrictis, basi plerumque attenuatis vel rotundatis, levibus, castaneo-brunneis, 36–56 x 17–27 μ, episporio 1.5–2 μ crasso; pedicello brunneolo, usque 46 μ longo; mesosporis paucis, ovatis vel ellipsoideis, apice magis incrassatis, 29–41 x 18–24 μ.

Puccinia coronata Corda

On *Rhamnus*, sp. **Yunnan**: Tungchuan, *4635*; Süanwei, *4453*; Hsiakwan, Tali, *4470*; Chichushan, Pinchuan, *4466*. On *R. leptophyllus*. **Szechuan**: Kwanhsien, *7118*, *7125*. On *Avena sativa*. **Yunnan**: Kunming, *7659*, *7930*; Sungming, *4641*; Tungchuan, *4620*, *4640*. On *Brachypodium sylvaticum*. **Yunnan**: Kunming, *7003*, *5033*, *7586*, *7608*. On *Calamagrostis* sp. **Szechuan**: Chengtu, *7544*. On *Bromus aspera*. **Yunnan**: Kunming, *7577*, *7624*, *7625*. On *Polypogon* sp. **Yunnan**: Kunming, *7762*. On *Polypogon luteolus*. **Yunnan**: Panchi, *7758*. On *Beckmannia Syzygachne*. **Yunnan**: Kunming, *7944*.

Puccinia invenusta Syd.

On *Phragmites Karka*. **Yunnan**: Kunming, *7000*, *7567*.

The uredospores and teliospores of the Yunnan fungus are slightly larger than those as originally described (uredospores 27–33 x 17–21 μ; teliospores 33–50 x 17–24 μ).

Puccinia Phragmitis (Schum.) Korn.

On *Phragmites communis*. **Yunnan**: Mengtze, *5092*; **Szechuan**: Chengtu, *4430*, *6829*.

Puccinia Eragrostidis-ferrugineae sp. nov.

FIGURE 10

On *Eragrostis ferruginea*. **Yunnan**: Kunming, December 20, 1939, *F. L. Tai*, *5024*, **type!** *5025*, *7731*.

Urediis amphigenis, plerumque hypophyllis, sparsis vel dense aggregatis, oblongis vel linearibus, 1–1.5 mm. longis, pulverulentis, aurantiacis; *uredosporis* subglobosis, ovoideis vel piriformibus, episporio 1.5–2 μ crasso, hyalino, echinulatis, 20–27 x 17–20 μ; *poris germinativis* sparsis 4–6 instructis. *Teliis* amphigenis, plerumque hypophyllis vel culmicolis, sparsis vel aggregatis, rotundatis, oblongis vel linearibus, confluentibus, 1–2 mm. longis, pulvinatis, brunneo-atris; *teliosporis* ellipsoideis vel late ellipsoideis, apice rotundatis vel obtuse acuminatis, basi rotundatis vel leniter attenuatis, apice leniter incrassatis (3–6 μ), episporio 1.5–2 μ crasso, medio non constrictis, levibus, castaneo-brunneis, 26–41 x 14–21 μ; *pedicello* hyalino, longiusculo, usque 113 μ longo.

This species differs from *Puccinia Eragrostidis* Petch in the larger uredia and telia, larger uredospores and teliospores; from *P. eragrostidicola* in the non-paraphysate and larger uredia, larger uredospores and slightly longer and narrower teliospores. The pedicel of the teliospore of the present fungus is also much longer.

Puccinia Festucae-ovinae sp. nov.

FIGURE 3

On *Festuca ovina*. **Yunnan**: Tali, May 21, 1940, *T. F. Yu & S. T. Chao*, *7834*, **type!**

Teliis amphigenis, plerumque epiphyllis, aggregatis vel sparsis, ellipticis vel oblongis, 0.5–0.8 mm. longis, pulvinatis, brunneo-atris; teliosporis ellipsoideis, rarius clavatis, apice plerumque rotundatis vel saepius acuminatis, leniter incrassatis (3–4 μ), basi plerumque rotundatis, saepius attenuatis, castaneo-brunneis, levibus, medio non vel leniter constrictis, 28–43 x 16–20 μ, episporio 1–1.5 μ crasso; *pedicello* hyalino, usque 57 μ longo, interdum lateraliter inserto.

This species is close to *Puccinia Crandallii*, but differs in the smaller thinner-walled and darker-colored teliospores, the apex of which is also thinner.

Puccinia Poae-sudeticae (Westend.) Jørstad

On *Poa annua*. **Szechuan**: Kwanhsien, *7117*, *7120*.

Puccinia graminis Pers.

On *Berberis pruinosa*. **Yunnan**: Kunming, *8163*; Chengkung, *4322*; Tungchuan, *4366*; Süanwei, *4321*. On *Mahonia Fortunei*. **Szechuan**: Omei-shan, *4432*. On *Triticum aestivum*. **Yunnan**: Anning, *4603*; Chengkiang, *4380*; Hsungtien, *4598*; Malung, *4602*; Lutien, *4611*; Tungchuan, *4599*; Jautung, *4596*; Süanwei, *4597*; Mengtze, *5345*. On *Hordeum vulgare*. **Yunnan**: Tsinling, *5383*; Hsungtien, *4607*; Jautung, *4606*; Kaiyuan, *5371*.

Puccinia glumarum (Schm.) Eriks. et Henn.

On *Triticum aestivum*. **Yunnan**: *5344*; Chengkung, *7394*; Tsinling, *7393*; Kunyang, *7392*; Yangling, *7283*; Chennan, *7282*; Chengkiang, *4378*; Hsungtien, *4594*; Sungming, *4163*; Jautung, *5384*; Tungchuan, *4592*; **Kweichow**: Meitan, *7670*; **Szechuan**: Chungking, *7397*. On *Hordeum vulgare*. **Yunnan**: Kunming, *5343*; Yuchi, *5378*; Lutien, *4604*; Tungchuan, *6202a*; Jautung, *4605*.

Puccinia rubigo-vera (DC.) Winter

On *Thalictrum dipterocarpum*. **Yunnan**: Kunming, *4390*. On *Agropyron semicostatum*. **Szechuan**: Kwanhsien, *7119*. On *Triticum aestivum*. **Yunnan**: Kunming, *4866a*; Lunan, *5326*; Tachwang, *5346*; I-Liang, *5361*; Mengtze, *5364*; Kaiyuan, *5178*; Hsungtien, *4595*; Chengkung, *4382*.

Puccinia Baryi (Berk. et Br.) Winter

On *Brachypodium sylvaticum*. **Yunnan**: Kunming, *4376*.

This rust is easily confused with *Puccinia glumarum* from which it is distinct in the paraphysate dark colored uredia, much shorter and slightly narrower teliospores, and uredospores with thicker and tinted walls.

Puccinia anomala Rostr.

On *Hordeum vulgare*. **Yunnan**: Kunming, *4612*; Chengkiang, *4384*; Sungming, *4613*; Tungchuan, *4616*; I-Liang, *5342a*; Lutien, *4606*; Tsinling, *5383*; Kaiyuan, *5371*.

Puccinia Arthraxonis (P. Henn.) Syd. et Butl.

On *Arthraxon* sp. **Yunnan**: Hsiakwan, Tali, *4766*.

Puccinia rufipes Diet.

On *Imperata cylindrica*. **Yunnan**: Tali, *7083*.

Puccinia Cacao MacAlpine

On *Rottboellia compressa*. **Yunnan**: Kunming, *7575*; **Szechuan**: Chengtu, *7614*.

Puccinia Phyllostachydis Kusano

On *Arundinaria* sp. **Yunnan**: Kunming, *5022*, *5021*, *5023*, *7190*. On *Bambusae*. **Yunnan**: Chichushan, Pinchuan, *8295*.

The writer in a previous publication (Sinensia **4**:113. 1933) erroneously referred a species of *Puccinia* on *Arundinaria* to *Puccinia Kusanoi* Diet. It should be *P. Phyllostachydis* Kusano.

Puccinia kwanhsienensis sp. nov.

FIGURE 7

On *Bambusa* sp. **Szechuan**: Kwanhsien, Oct. 11, 1936, *L. Ling*, *6852*, **type!**

Teliis amphigenis, rotundatis, ellipticis vel oblongis, sparsis vel aggregatis, pulvinatis, 0.35–0.8 mm. longis, atris; *teliosporis* ellipsoideis vel ellipsoideo-oblongis, apice rotundatis, truncatis vel acutiusculis, incrassatis (3–11 μ), basi leniter attenuatis, pallide castaneo-brunneis, levibus, medio non vel leniter constrictis, 37–57 x 15–23 μ, episporio 1.5–2.5 μ crasso; *pedicello* brunneolo, sporam subaequante; paraphysibus capitatis vel clavatis, brunneolis, 54–60 μ longis, apice 16–19 μ crassis; *uredosporis* immixtis globosis, 18–20 μ diam., flavo-brunneis, echinulatis, episporio ca. 2.8 μ crasso, *poris germinativis* 4 sparsis instructis.

ON CYPERACEAE

Puccinia Romagnoliana Maire et Sacc.

On *Cyperus difformis*. **Yunnan**: I-Liang, *7810*. On *C. rotundus*. **Yunnan**: Wenshan, *5745*. On *C.* sp. **Yunnan**: Chaopa, *7811*.

Uredia hypophyllous and caulicolous, on black elongated spots, scattered or gregarious, roundish, elliptic or oblong, 0.5–2 mm. long, at first bullate, covered by epidermis, then ruptured by a longitudinal slit, pulverulent, cinnamon brown; *uredospores* subglobose or ovoid, epispore 2–3 μ thick, pale cinnamon brown, prominently echinulate, 21–30–(34) x 16–23 μ; *pores* 2 approximately equatorial. *Telia* similar, oblong or linear, often confluent into groups, 1–3 mm. long, pulvinate, brownish black; *teliospores* fusoid-oblong or clavate, obtusely acuminate, rounded or rarely truncate at the apex, apex thickened (4–11 μ), narrowed below, epispore 1–1.5 μ thick, chestnut brown at apex, paler below, slightly constricted at septum, 36–67 x 13–20 μ, smooth; *pedicel* brownish, short; *paraphyses* numerous subepidermal between telia; *mesospores* present.

The collections listed above differ from *P. Cyperi* in the thicker-walled uredospores with only 2 germ pores; from *P. canaliculata* and *Uredo cypericola* in the thicker-walled and larger uredospores; from *P. Cyperi-tagetiformis* Kern and *P. philippinensis* in the larger uredospores and teliospores,

and from *Uredo Cyperi-tagetiformis* P. Henn. in the smaller uredospores. The characters of the forms studied agree better with the description of *P. Romagnoliana* than that of the other species.

Puccinia Juncelli Diet.

On *Cyperus serotinus*. **Yunnan**: Kunming, *7809*.

Telia hypophyllous, elliptic, oblong or linear, 0.35–2.5 mm. long, covered by epidermis, black; *teliospores* oblong, clavate, rarely ellipsoid, rounded, conical or rarely truncate at apex, rounded or usually narrowed at base, epispore 1–1.5 μ thick, apex thickened (4–7 μ), not or slightly constricted at septum, chestnut brown at apex, paler below, 43–63 x 16–23 μ; *pedicel* about half as long as the spore, brownish or yellowish brown; *mesospores* present. Intermixed *uredospores* ovoid, ellipsoid or globoid, epispore thin, about 1.5 μ thick, brownish, finely and sparingly echinulate, 29–40 x 22–28 μ; *pores* 4 equatorial.

Puccinia liberta Kern

On *Eleocharis tuberosus*. **Fukien**: Shaowu, *8294*.

Puccinia constata Syd.

On *Carex baccans*. **Yunnan**: Kunming, *7598*, *7814*.

Puccinia Yokokurae P. Henn.

FIGURE 23

On *Carex heterolepis*. **Hopei**: Peiping, *8432*.

Uredia hypophyllous, scattered or subgregarious, roundish or elliptic, 0.35–0.5 mm. long, cinnamon brown, pulverulent; *uredospores* ovoid, globoid or ellipsoid, finely and sparingly echinulate, epispore 2–2.5 μ thick, cinnamon brown or paler, 20–27 x 16–21 μ; *pores* 2–3 equatorial.

Telia hypophyllous, scattered or subgregarious, roundish or linear, 0.35–1 mm. long, pulvinate, black; *teliospores* oblong-clavate or clavate, apex rounded, truncate or acuminate, thickened (8.5–11 μ), chestnut-brown above, paler and rounded or usually narrowed below, smooth, 1.5–2 μ thick at sides, (36)–42–53–(61) x 16–21 μ, usually constricted at septum; *pedicel* brownish, usually shorter than the spore; *mesospores* present.

The measurements of the spores and other characters of this form agree well with the description of *P. Yokokurae*. Unfortunately, in the original description of the latter species, the thickness of the walls, and number and position of the germ pores of the uredospore, which are important characters in the identification of the rust fungi on *Carex*, are not mentioned.

Puccinia Caricis (Schum.) Rebent.

On *Carex cruciata*. **Szechuan**: Kwanhsien, *7127*.

ON JUNCACEAE

Puccinia obscura Schroet.

On *Luzula multiflora*. **Yunnan**: Tali, *7100*.

ON LILIACEAE

Puccinia pachycephala Diet.

On *Veratrum* sp. **Hunan**: Hengshan, *4756*.

The teliospores of the present plant measure 40–67 x 18–24 μ, narrower than those given in the diagnosis of *P. pachycephala*.

Puccinia veratricola sp. nov.

FIGURE 20

On *Veratrum taliense*. **Yunnan**: Changshan, Tali, Aug. 26, 1938, *H. S. Yao, 5046*, **type!**

Uredíis amphigenis, plerumque hypophyllis, rotundatis vel ellipticis, 0.35–0.5 mm. longis, diutius epidermide tectis, dein ea longitudinaliter fissa cinctis, pulverulentis, flavidis; uredosporis subglobosis, globosis vel ovoideis rarius ellipsoideis, echinulatis, flavidis vel hyalinis, 20–26 x 17–19 μ, episporio 2–2.8 μ crasso, *poris germinativis* indistinctis. *Teliis* conformibus, diutius epidermide tectis, atris; *teliosporis* oblongis vel clavatis, apice rotundatis, truncatis vel conico-attenuatis, incrassatis (3–6 μ), basi rotundatis vel attenuatis, medio non vel leniter constrictis, levibus, flavo-brunneis, apice obscurioribus, 41–49 x 16–17 μ, episporio 1–1.5 μ crasso; *pedicello* brevi, brunneolo.

Puccinia Hemerocallidis Thuem.

On *Hemerocallis* sp. **Yunnan**: *6878*, *7580*, *8048*; Tali, *4546*, *5045*.

The Chinese forms have smaller teliospores (31–57 x 14–20 μ) and no paraphyses. They might not be identical with *P. Hemerocallidis*.

Puccinia Porri (Sow.) Winter

On *Allium fistulosum*. **Yunnan**: Kunming, *4836*, *4585*, *5179*; Chengkung, *4387*, *4861*. On *A. sativum*. **Yunnan**: Kunming, *4586*, *4587*, *5185*.

Puccinia ferruginea Lev.

On *Smilax longipes*. **Yunnan**: Cheli, *7024*. On *S.* sp. **Kweichow**: Meitan, *7934*. On *Heterosmilax Gaudichaudiana*. **Fukien**: Yungan, *7959*.

According to the Sydows (Monogr. Ured. **1**:635) *P. Smilacis-chinae* is distinct from *P. ferruginea* in the smaller and somewhat less compact telia, smaller, lighter-colored teliospores and shorter and hyaline pedicel. A study of specimens from different parts of China shows that the differences as pointed out by the Sydows do not hold good. For instance, the collection no. *7934* has longer teliospores (54–84 x 16–24 μ), but the telia are only 0.5–0.8 mm. in diameter and the teliospores are yellowish in color with pedicels up to 122 μ long. The size of the telia and the teliospores of the collection no. *7024* corresponds closely with that of *P. Smilacis-chinae*, but the color of the teliospore varies from yellowish to brownish yellow, and the pedicels are yellowish, up to 102 μ long.

Pycnial and aecial stages were found by Arthur and Cummins (Philippine Jour. Sci. **59**:446. 1936) on a collection identified by them as *P. Smilacis-chinae* from the Philippines. Those stages were considered by them to belong with this species. The *Aecidium* so far collected on *Smilax* in China is *A. Smilacis* Schw.

Puccinia Smilacis Schw.

On *Smilax* sp. **Hunan**: Yolushan, Changsha, *4573*; Hengshan, *4476, 4475, 4478*; **Yunnan**: Kunming, *4840*.

Puccinia Smilacis-sempervirentis Wang (Bull. Mus. Nat. Hist. Nat. (Paris) ser. 2, **10**:523. 1938) differs from *P. Smilacis* mainly in the amphigenous and blackish-brown telia which are aggregated in groups. On the collections nos. *4573* and *4478* listed above, the telia, although hypophyllous, often aggregate in groups (1.5--2.5 mm. in diam.), and the telia of all the collections the writer studied are dark chestnut brown in color, not black as described in the original diagnosis. *P. Smilacis-sempervirentis* might be identical with *P. Smilacis*.

ON IRIDACEAE

Puccinia Iridis (DC.) Wallr.

On *Iris ensata*. **Kansu**: Wuwei, *8391*; Chang-I, *8418*; Yungdun, *8410*.

ON ZINGIBERACEAE

Puccinia Roscoeae Barcl.

FIGURE 26

On *Roscoea intermedia*. **Yunnan**: Kunming, *7964*. On *Camptandra yunnanensis*. **Yunnan**: Chichushan, Pinchuan, *5066*.

ON POLYGONACEAE

Puccinia Muehlenbeckiae (Cooke) Syd.

FIGURE 27

On *Muehlenbeckia platycladia*. **Kiangsu**: Nanking, *8433*.

Puccinia Acetosae (Schum.) Korn.

On *Rumex dentatus*. **Yunnan**: Kunming, *6081, 7836*.

Puccinia punctiformis Dietel et Holway

On *Rumex nepalensis*. **Yunnan**: Kunming, *4397*; Chengkung, *7630*. On *R. crispus*. **Szechuan**: Kwanhsien, *7128*.

Eight species of *Puccinia* have been reported on the genus *Polygonum* from China: *P. mamillata* Schroet., *P. Fagopyri*, *P. congesta*, *P. Bistortae*, *P. Polygoni-amphibii*, *P. Polygoni-lapathifolii*, *P. nitidula* and *P. calumnata*. An examination of the type specimen of *P. Polygoni-lapathifolii*, made available through the kindness of Dr. T. N. Liou, shows that it is identical with *P. Polygoni-Wejrichii* Miyake.

More than 20 species of *Puccinia* have been described on *Polygonum*. Only 17 of these species seem to be valid. In the course of studying the rust collections on *Polygonum* from the province of Yunnan an attempt has been made by the writer to study all the species of *Puccinia* so far described on that genus. Unfortunately authentic specimens of several of these spe-

cies are not available for study. In this paper 7 species of *Puccinia* on *Polygonum* are recorded; 3 are described as new.

Puccinia congesta B. et Br.

On *Polygonum Dielsii*. **Yunnan**: Kunming, *5008*.

Telia aggregated into small roundish groups on brown spots, pulvinate, roundish, sometimes confluent, cinnamon brown, minute, about 0.3 mm. in diameter, the groups 1.5–3 mm. in diameter; *teliospores* ellipsoid-oblong or oblong, thin-walled, not thickened at apex, smooth, brownish, constricted at septum, rounded at apex, rounded or usually tapering towards the base, germinating on maturity, 37–50 x 16–21 μ (43 x 19 μ); *pedicel* persistent, hyaline, up to 77 μ long.

Petch suggested that *P. congesta* might be identical with *P. Solmsii* (Ann. Roy. Bot. Gard. Peradeniya **5**:233. 1912). Specimens collected at Kunming have been compared with those of Java (*P. Solmsii*), Raciborski *63*, and India (3 collections, of which two are labelled *P. congesta* and one *P. Solmsii*), and found to be the same. No uredia have been observed on any of the specimens. In the description of *P. consimilis* P. Henn., a synonym of *P. Solmsii*, uredospores have been described ("18–26 x 15–24, levibus, castaneis"). According to the size and other characters of the uredospores in that description the supposed uredospores are evidently cells of the teliospore which have fallen apart as has already been pointed out by the Sydows (Mon. Ured. **1**:568. 1904). In 1912 Petch on redescribing *P. congesta* gave, however, description of a uredial stage which was not mentioned in the original diagnosis nor found in all the collections including one from Ceylon the present writer studied. It is hoped that some local mycologist in Ceylon will re-examine the specimens studied by Petch and clear up the question of the uredial stage.

Puccinia Polygoni-amphibii Pers.

On *Polygonum cuspidatum*. **Yunnan**: Kunming, *5014*; **Hunan**: Hengshan, *5013*, *5016*; **Szechuan**: Omeishan, *6834*; **Chekiang**: Hangchow, Univ. Nanking, Path. Herb. no. *2421*. On *P. multiflorum*. **Yunnan**: Kunming, *5009*, *5021*.

The number and position of the pores of the uredospore of the above collections are variable. Thus, the uredospores of collections nos. *5013*, *5014*, *5016* (on *Polygonum cuspidatum*), *5009* and *5002* (on *Polygonum multiflorum*) have 2 to 4 equatorial pores. Only two superequatorial pores are present in the uredospores of the collection Univ. Nanking no. *2421*, while collection no. *6834* has uredospores with 2 to 4 superequatorial or equatorial pores.

Puccinia polygonicola sp. nov.

FIGURE 15

On *Polygonum chinense*. **Hunan**: Hengshan, November 16, 1937, *C. C. Chco*, *5004*, **type!** On *P. nepalense*. **Yunnan**: Kunming, *5000*, *5001*,

7596; **Szechuan**: Kwanhsien, *6314*. On *P. caespitosum*. **Hunan**: Hengshan, *5003*, *5013*; **Yunnan**: Lunan, *7761*.

Uredíis amphigenis, plerumque hypophyllis, sparsis vel aggregatis, rotundatis, 1–1.5 mm. diam., pulverulentis, cinnamomeo-brunneis; *uredosporis* subglobosis, ovoideis, rarius ellipsoideis echinulatis, pallide cinnamomeo-brunneis, 20–30 x 16–23 μ, episporio 1.5–2.0 μ crasso, *poris germinativis* 2–3 in parte basali praeditis.

Teliis amphigenis, plerumque hypophyllis, sparsis vel dense aggregatis, rotundatis vel ellipticis, 0.5–1.5 mm. diam., confluentibus vel circinatim dispositis, pulvinatis, atris; *teliosporis* oblongis vel clavatis, apice valde incrassatis (6–10 μ), rotundatis vel truncatis rarius acuminatis, basi plerumque attenuatis, levibus, castaneo-brunneis, medio non vel parum constrictis, 30–53 x 15–24 μ; episporio 1.5–2 μ crasso; *pedicello* hyalino, brevi.

This species is close to *Puccinia yunnanensis* but differs in the larger uredia and telia, and longer and broader teliospores which are much thickened at apex (6–10 μ).

Puccinia yunnanensis sp. nov.

FIGURE 16

On *Polygonum cymosum*. **Yunnan**: Hsiakwan, Tali, August 21, 1938, *C. C. Cheo* and *H. S. Yao*, *5005*, **type!** Kunming, *5291*, *7686*.

Uredíis hypophyllis, sparsis vel gregariis, rotundatis, ca. 0.5 mm. diam., pulverulentis, cinnamomeo-brunneis; *uredosporis* subglobosis vel ellipsoideis, echinulatis, pallide cinnamomeo-brunneis, 23–29 x 16–20 μ, episporio 1.5–2 μ crasso, *poris germinativis* 1 vel 2 juxta pedicelli insertionem praeditis. *Teliis* hypophyllis, sparsis vel gregariis 0.35–0.5 mm. diam. compactis, atris; *teliosporis* plerumque oblongis vel oblongo-clavatis, apice parum incrassatis (3–7 μ), rotundatis vel truncatis, medio non vel leniter constrictis, basi rotundatis vel attenuatis, castaneo-brunneis, levibus, 23–47 x 16–20 μ, episporio 1.5–2.5 μ crasso; *pedicello* hyalino, brevi.

Puccinia taliensis sp. nov.

FIGURE 12

On *Polygonum paleaceum* var. *pubifolium*. **Yunnan**: Changshan, Tali, August 26, 1938, *C. C. Cheo*, *5018*, **type!** *5019*, *5020*, *4568*. On *P. viviparum*. **Yunnan**: Changshan, Tali, *5017*.

Uredíis amphigenis, plerumque hypophyllis, aggregatis vel sparsis, rotundatis, 0.5–0.8 mm. diam., pulverulentis, cinnamomeo-brunneis; *uredosporis* subglobosis vel globosis, echinulatis, cinnamomeo-brunneis, 21–24 x 20–23 μ, episporio 3–3.6 μ crasso, *poris germ.* 4–5 sparsis praeditis.

Teliis amphigenis, plerumque hypophyllis, sparsis vel gregariis, rotundatis, subpulverulentis, 0.25–0.5 mm. diam., confluentibus, atro-brunneis; *teliosporis* ellipsoideis vel ellipsoideis-oblongis, apice rotundatis vel acuminatis, incrassatis (6–7 μ), basi rotundatis vel attenuatis, medio non vel parum constrictis, castaneo-brunneis, levibus vel minutissime verrucosis, 30–51 x 19–26 μ (36 x 20 μ); episporio 2–3 μ crasso; *pedicello* hyalino, persistente, usque 78 μ longo.

This species is close to *P. sachalinensis* Pat. et Har., but differs in the sometimes minutely verrucose, longer and broader teliospores with less thickened apex.

Puccinia Fagopyri Barcl.

On *Polygonum cymosum*. **Yunnan**: Chichushan, Pinchuan, *5002*; **Hunan**: Hengshan, *5011, 5015*. On *P. capitatum*. **Yunnan**: Hsiakwan, Tali, *4999*.

Puccinia Polygoni-Wejrichii Miyake

On *Polygonum lapathifolium*. **Shantung**: Muping, August 21, 1933, *T. N. Liou* and *K. M. Liou, 1274*, **type** of *P. Polygoni-lapathifolii* Liou et Wang.

The type of *P. Polygoni-lapathifolii* of Liou and Wang has been studied again by the present writer, and is doubtless identical with *P. Polygoni-Wejrichii* Miyake, published in 1931, in spite of the fact that the type of the latter has not been seen.

ON CARYOPHYLLACEAE

Puccinia Behenis Otth.

On *Cucubalus baccifer*. **Yunnan**: Kunming, *5050*.

Puccinia Arenariae (Schum.) Wint.

On *Stellaria saxatilis*. **Yunnan**: Kunming, *7832*. On *S. paniculata*. **Yunnan**: Shueili, *5058*.

Puccinia Stellariae Liou and Wang described from North China is apparently identical with this species.

ON RANUNCULACEAE

Puccinia clematidicola sp. nov.

FIGURE 14

On *Clematis connata*. **Yunnan**: Chichushan, Pinchuan, Sept. 11, 1938, *H. S. Yao, 4540*, **type!**

Teliis epiphyllis, solitariis vel circinatim dispositis, rotundatis, 0.25–1 mm. diam., primo tectis epidermide, demum fissa cinctis, pulverulentis, castaneo-brunneis; *teliosporis* ellipsoideis vel fusoideo-oblongis, apice attenuatis, papilla majuscula hyalina auctis, basi rotundatis vel attenuatis, medio non constrictis, 41–57 x 20–26 μ, castaneo-brunneis, levibus, episporio 2–3 μ crasso; *pedicello* hyalino, fragili, spora breviore, subinde lateraliter inserto.

Puccinia Wattiana Barcl.

FIGURE 22

On *Clematis Peterae*. **Yunnan**: Kunming, *4838*. On *C.* sp. **Yunnan**: Wenshan, *4374, 4439*.

Telia amphigenous, chiefly hypophyllous, densely gregarious into small groups (3–4 mm. in diam.), usually circinately arranged, roundish, 0.3–0.5 mm. in diameter, often confluent, at first covered by epidermis, finally ruptured, compact, chestnut brown; *teliospores* ovate, broadly ovate or oblong, rounded or slightly attenuated at both ends, flat hyaline papillae over the pores, not thickened at apex, not or slightly constricted at septum, 2 kinds

of *spores*: thin-walled spores 1.5–2 μ thick, cinnamon-brown or paler, thick-walled spores 2–3 μ thick, chestnut brown, pore of the upper cell apical or slightly depressed, that of the lower lateral or near the hilum, 31–43 x 19–24 μ; *pedicel* fragile usually short, sometimes as long as the spore; spores germinating immediately; *mesospores* numerous, various in shape, 27–37 x 14–19 μ. As far as description is concerned *Puccinia exhausta* Diet. does not seem to differ from this species.

ON BERBERIDACEAE

Puccinia Epimedii (P. Henn.) Miyabe et Ito

On *Epimedium* sp. **Szechuan**: Omeishan, *6835*; **Shensi**: Linkiang, *4805*; Chengku, *4306*.

ON LAURACEAE

Puccinia Cinnamomi sp. nov.

FIGURE 11

On *Cinnamomum* sp. **Szechuan**: Omeishan, Aug. 1, 1936, *L. Ling*, *6839*, **type!**

Teliis amphigenis, plerumque hypophyllis, sparsis vel subgregariis, rotundatis, 1–1.5 mm. diam., pulverulentis, cinnamomeo-brunneis vel castaneo-brunneis; *teliosporis* fusiformibus vel longe clavatis, apice rotundatis vel attenuatis, leniter incrassatis (3–4 μ), basi attenuatis, medio non vel leniter constrictis, levibus, castaneo-brunneis vel cinnamomeo-brunneis, 60–110 x 12–20 μ, episporio 1.5–2 μ crasso; *pedicello* hyalino, fragili, gracili (4 μ lato), plerumque brevi, subinde sporum aequante.

In the telia of the present fungus there are dispersed here and there minute, hard, black and roundish galls (0.35–0.5 mm. in diam.). The teliospores are produced among these galls. There occur two kinds of teliospores: the thick-walled ones are shorter and narrower (60–90 x 12–19 μ), while the thin-walled ones are longer and broader (66–111 x 14–20 μ).

ON ROSACEAE

Puccinia Pruni-persicae Hori

On *Prunus persica*. **Hunan**: Hengshan, *4722*, *4751*.

ON LEGUMINOSAE

Puccinia Glycyrhizae sp. nov.

FIGURE 17

On *Glycyrhiza aspera*. **Kansu**: Tungwei, June 29, 1943, *W. L. Hsian*, *8402*, **type!**

Urediis amphigenis, plerumque hypophyllis, totum folium occupantibus, rotundatis, 0.25–0.5 mm. diam., pulverulentis, cinnamomeo-brunneis; *uredosporis* plerumque globosis, subglobosis vel ovatis, brunneolis, subtiliter echinulatis, 26–31 x 21–24 μ, episporio 1.5–2 μ crasso, *poris germ.* 2–3 aequatorialibus. *Teliis* conformibus, castaneo-brunneis; *teliosporis* ovatis vel late ovatis, utrinque rotundatis, basi rarius leniter attenuatis, dense verruculosis, cinnamomeo-brunneis, medio non vel leniter constrictis, 30–37 x 19–24 μ,

episporio 2.5–3.0 μ crasso; *pedicello* fragili, hyalino, brevi, plerumque lateraliter inserto; *mesosporis* paucis immixtis.

ON BALSAMINACEAE

Puccinia Impatientis-uliginosae sp. nov.

FIGURE 19

On *Impatiens uliginosa*. **Yunnan**: Puchi, Kunming, October 25, 1941, *F. L. Tai, 7785*, **type!** *7826*.

Urediis amphigenis, plerumque hypophyllis, rotundatis, sparsis vel gregariis, 0.5–1 mm. diam., pulverulentis, cinnamomeo-brunneis; *uredosporis* globosis vel ovatis, rarius ellipsoideis, echinulatis, pallide cinnamomeo-brunneis, 20–30 x 18–20 μ, episporio 1.5–2 μ crasso, *poris germinativis* 2–4 aequatorialibus. *Teliis* conformibus, subpulverulentis, brunneo-atris; *teliosporis* plerumque ellipsoideis vel oblongis, apice attenuatis vel rotundatis, papilla majuscula brunneola auctis, basi rotundatis subinde attenuatis, levibus, castaneo-brunneis, 31–51 x 17–23 μ, episporio 1.5–2.5 μ crasso; *pedicello* hyalino, brevi; *mesosporis* paucis immixtis.

This fungus is close to *Puccinia argentata*, but is distinct in the larger, darker-colored and thicker-walled uredospores and teliospores. It also differs from *P. Komarovi* in the 2 to 4 equatorial pores of the uredospore and longer teliospores.

ON MALVACEAE

Puccinia Abutili Berk. et Br.

On *Abutilon Gebauerianum* ? **Yunnan**: Yuankiang, *6464*, *4500*; Shihping, *6687*.

Puccinia heterospora Berk. et Curt.

On *Abutilon avicennae* ? **Yunnan**: Kaiyuan, *5065*.

ON VIOLACEAE

Puccinia Violae (Schum.) DC.

On *Viola Patrinii*. **Szechuan**: Kwanhsien, *7122*. On *V. betonicifolia*. **Szechuan**: Kwanhsien, *7116*; Omeishan, *7545*.

ON ONAGRACEAE

Puccinia Circaeae Pers.

On *Circaea imaicola*. **Yunnan**: Kunming, *5044*.

ON UMBELLIFERAE

Puccinia Oenanthes (Diet.) Miyake

On *Oenanthe stolonifera*. **Szechuan**: Chengtu, *6851*.

ON PRIMULACEAE

Puccinia Dieteliana Syd.

On *Lysimachia clethroides*. **Hunan**: Hengshan, *4754*, *4755*. On *L.* sp. **Szechuan**: Omeishan, *6837*.

ON GENTIANACEAE

Puccinia Swertiae Wint.

On *Swertia* sp. **Yunnan**: Tali, *4645*.

ON CONVOLVULACEAE

Puccinia Convolvuli (Pers.) Cast.

On *Calystegia hederacea*. **Yunnan**: Kunming, *8434*.

ON LABIATAE

Puccinia Menthae Pers.

On *Mentha arvensis*. **Yunnan**: Lunan, *7256*; Sungming, *4394*; Kunming, *5048*.

Puccinia Leucadis Syd.

On *Leucas ciliata*. **Yunnan**: Kunming, *7963*, *8149*.

Puccinia leucophaea Syd. et Butl.

FIGURE 13

On *Colquhounia coccinea*. **Yunnan**: Changshan, Tali, *4445*; Hsiakwan, *4419*; Chichushan, Pinchuan, *4440*, *5071*, *5072*.

Pycnia epiphyllous, gregarious in the center of spots, often surrounded by aecia, 80–180 μ in diameter. *Aecia* amphigenous, mainly epiphyllous, on yellow orbicular spots (2–4 mm. in diam.), gregarious, cylindrical, 0.5–1 mm. long, 260–360 μ wide; *peridial cells* subrhomboid or oblong, 31–45 x 21–26 μ, exterior walls striate, 6–8.6 μ wide, interior 3–4 μ wide, verrucose; *aeciospores* globose or ovate, coarsely verrucose, yellowish or subhyaline, epispore 2–3 μ thick, 21–30 x 18–26 μ. *Uredia* amphigenous, mainly hypophyllous, scattered or subgregarious, roundish, 0.2–0.5 mm. in diameter, pulverulent, cinnamon brown; *uredospores* globose, subglobose or rarely ovate, sparingly echinulate, pale cinnamon brown, epispore 1–1.5 μ thick, 23–27 x 18–24 μ; *pores* 2–3 scattered. *Telia* similar, chestnut brown; *teliospores* of two types: thin-walled ones, the prevalent type, various in shape, usually ellipsoid or oblong, epispore 1–1.5 μ thick, pale cinnamon brown, 27–56 x 18–27 μ, thick-walled ones ellipsoid, epispore 3–4 μ thick, chestnut brown, 33–46 x 21–27 μ, smooth, yellowish conic or hemispheric papillae over the pores, pore of the upper cell apical, that of the lower at the septum; *pedicel* hyaline, fragile, usually short, sometimes 1–2 times the length of the spore.

The uredospores of the Yunnan fungus are smaller and the teliospores much narrower than those originally described for *P. leucophaea*.

ON ACANTHACEAE

Puccinia Shiraiana Syd.

On *Justicia xerobatica*. **Yunnan**: Kunming, *4389*, *7946*. On *J. procumbens*. **Fukien**: Yungan, *7503*.

Three species of *Puccinia* have been described on *Justicia*: *P. Thwaitesii*, *P. Shiraiana* and *P. peraffinis*. According to the description *P. Thwaitesii* is distinct from the other two in the large size of the teliospores and the absence of mesospores. *P. peraffinis*, according to Sydow, differs from *P. Shiraiana* mainly in the slightly thickened apex and distinct constriction at the septum. The teliospore of Chinese forms of *Puccinia* on the genus *Justicia* so far studied by the writer all have a slightly thickened apex and are not or slightly constricted at the septum. As the authentic specimens of *P. peraffinis* are not available for study, it is difficult to decide whether to refer these Chinese plants to *P. peraffinis* or to *P. Shiraiana*; the apex of the latter is stated in the original diagnosis to be not thickened. The writer is inclined to the opinion that when the type of *P. peraffinis* is re-examined and compared with *P. Shiraiana*, it will be found to be identical.

ON RUBIACEAE

Puccinia punctata Link

On *Galium* sp. **Yunnan**: Kunming, *4442*.

ON VALERIANACEAE

Puccinia Patrinae P. Henn.

On *Patrina* sp. **Hunan**: Hengshan, *4745*.

ON COMPOSITAE

Puccinia Helianthi Schw.

On *Helianthus annuus*. **Yunnan**: Chengkung, *4388*.

Puccinia Saussureae-ussuriensis Liou et Wang

FIGURE 21

On *Saussurea* sp. **Hunan**: Hengshan, *4523*.

Telia hypophyllous on orbicular spots with ashy centers (1.5–2.5 mm. in diam.), roundish, minute, 0.35–0.5 mm. in diameter, gregarious in scattered small groups (1.5–2 mm. in diam.), pulvinate, dark brown; *teliospores* ellipsoid, oblong or clavate, acuminate or usually rounded, rarely truncate at apex, rounded or attenuated below, apex not or slightly thickened (3–6 μ), 1–1.5 μ thick at sides, smooth, slightly constricted at septum, often 2 or 3 septate, yellowish or subhyaline, pore of the upper cell apical or depressed, of the lower at the septum, 40–63 x 16–20 μ, germinating *in situ*; *pedicel* persistent, hyaline, as long as the spore but usually shorter, rarely laterally attached; *mesospores* few, present.

This species differs from *P. Saussureae* Thuem., *P. Ivantzkiae* Tranzs. and *P. Saussureae-alpinae* Liro in the smooth and larger spores. It is very close to *P. Vomica* Thuem. in the size of the spores, but differs in that the telia of the latter are larger (2–4 mm.) and solitary, while those of the present plant are aggregated and only 0.35–0.5 mm. in diameter. Besides, the apex of the teliospore of the Chinese plant is less thickened. It, however,

corresponds very well with the description of *P. Saussureae-ussuriensis* Liou et Wang (Contr. Inst. Bot. Nat. Acad. Peiping **3**:447. 1938) except that the *Caeoma* stage which they reported is not present in the Hunan collections.

Puccinia Millefolii Fckl.

On *Artemisia japonica*. **Yunnan**: Kunming, *4525*. On *A. vulgaris*. **Yunnan**: Kunming, *4373*.

The plants of these collections fit well with *P. ferruginosa* in the measurements of the spores etc., but *P. ferruginosa* does not seem to differ essentially from *P. artemisiicola* and *P. Millefolii*. The present writer follows Teng (Sinensia **8**:276. 1937) in considering *P. ferruginosa* as a synonym of *P. Millefolii*. *P. phragmoides* Liou et Wang (Contr. Inst. Bot. Nat. Acad. Peiping **1**:158. 1934) which is said to be distinct from *P. artemisiicola* only in the presence of 3 or 4 celled teliospores should also be considered as synonymous.

Puccinia absinthii DC.

On *Artemisia mongolica*. **Yunnan**: Kunming, *8154*. On *A. dubia*. **Yunnan**: Kunming, *8155*. On *A. japonica*. **Hunan**: Huanhsien, *4803*.

Puccinia Schirajewskii Tranzsch.

On *Serratula* sp. **Kansu**: Wuwei, *8403*.

Puccinia Carthami Corda

On *Carthamus tinctorius*. **Kansu**: Chang-I, *8435*.

Puccinia minussensis Thuem.

On *Lactuca indica*. **Yunnan**: Kunming, *7922*, *7948*; Chengkung, *7632*; **Szechuan**: Chengtu, *8488*; **Kansu**: Tungwei, *8401*.

It seems that *P. lactucicola* Miura should be reduced as a synonym of *P. minussensis*. It was stated that the former is very close to *P. hemisphericum*, a synonym of *P. minussensis*, except that the pore of the lower cell is situated ⅔–¾ from the septum ! (Ann. Mycol. **11**:96. 1913).

Puccinia Lactucae-repentis Miyabe et Miyake

On *Lactuca versicolor*. **Yunnan**: Chengkung, *7633*. On *L.* sp. **Szechuan**: Chengtu, *8423*.

Pycnia amphigenous, scattered. *Aecia* amphigenous, chiefly hypophyllous, isolated or gregarious (2–10), shortly cupulate, margin straight, lacerate, white, 230–380 μ in diameter; *peridial cells* rhomboid or oblong, 24–36 x 15–19 μ, exterior walls 4–6 μ thick, striate, interior 1.5–2.8 μ thick, minutely and densely verrucose; *aeciospores* subglobose or ellipsoid, angular, densely verruculose, epispore 1–1.5 μ thick, hyaline, 13–26 x 11–18 μ. *Uredia* amphigenous, mostly hypophyllous, scattered or subgregarious, 0.25–0.5 mm. in diameter, roundish, pulverulent, cinnamon brown; *uredospores* subglobose or ovoid, epispore 1.5–2 μ thick, pale cinnamon brown,

finely echinulate, 18–24 x 17–20 μ; *pores* 3–4 scattered, not covered by a swollen cap. *Telia* similar roundish, 0.35–1 mm. in diameter, sometimes confluent, pulverulent, chestnut brown; *teliospores* broadly ovate or ellipsoid, rarely subglobose, not or hardly constricted at septum, apex not thickened, rounded at both ends, epispore 1–1.5 μ thick, chestnut brown, 26–37 x 20–24–(29) μ, minutely verruculose, sometimes smooth near the base, pore of the upper cell apical or much depressed, that of the lower near the septum or depressed; *pedicel* short, hyaline, fragile, usually laterally attached.

The plants of the collections listed above correspond closely with the decription of *Puccinia Lactucae-repentis* except that the present plants have a uredial stage, and slightly broader teliospores. The writer has compared these Chinese forms with one from Japan (On *Lactuca repens*, Zenibako, Shiribeshi, Japan, Oct. 9, 1924, *Naohide Hiratsuka*, no. *561*, *ex* Herbarium Hiratsuka) and found they are the same except that the uredial stage is lacking in the collection from Japan. The teliospores of the Japanese plant are about of the same size as those of the Chinese forms, measuring 26–34 x 17–23 μ. The omission of the uredial stage in the Japanese form may be ascribed to the different growth conditions in Japan as in the case of *Puccinia Acetosae* which has its uredial stage suppressed in northern Europe or at high altitudes.

Puccinia Lactucae-debilis Diet.

On *Lactuca debilis*. **Hopei**: Paoting, *8422*.

Only the aecial stage is present. The measurements of the aeciospores and other characters fit well with the description of *Aecidium Lactucae-debilis*, but it could be referred to *Puccinia Lactucae-debilis* just as well.

UREDINALES IMPERFECTI

AECIDIUM Pers.

Aecidium Smilacis Schw.

On *Smilax china*. **Kiangsu**: I-Hsin, *8438*.

Aecidium Dispori Diet.

On *Disporum pullum*. **Szechuan**: Kwanhsien, *8443*.

Aecidium Mori Barcl.

On *Morus alba*. **Yunnan**: Kunming, *4307*; Chengkiang, *4308*; Mengtze, *4309*. On *M. australis*. **Yunnan**: Kunming, *7921*.

Aecidium orbiculare Barcl.

On *Clematis* sp. **Yunnan**: Süanwei, *4391*.

Aecia on stem causing cylindrical swelling, gregarious, cupulate or short cylindrical, up to 1 mm. long, 0.5–0.7 mm. wide, yellowish, margin lobed, revolute; *peridial cells* rhomboid, outer walls 4–6 μ thick, striate, inner about 2 μ thick, coarsely verrucose; *aeciospores* globose, subglobose or

ovate, epispore 1–1.5 μ thick, hyaline, minutely and densely verrucose, 16–21 x 14–17 μ.

Aecidium Machili P. Henn.

On *Machilus Bournei*. **Szechuan**: Kwanhsien, *6843*, *7124*.

Aecidium Pourthiaeae Syd.

On *Photinia* sp. **Hunan**: Hengshan, *4310*.

This species differs from *Gymnosporangium japonicum* in the lighter colored and thin-walled aeciospores and different peridial cells. Tanaka and Arthur considered this species as a synonym of *G. japonicum*. The writer agrees with the Sydows in considering it as distinct.

Aecidium Campylotropidis sp. nov.

On *Campylotropis polyantha*. **Yunnan**: Kunming, July 1938, *F. L. Tai*, *5041*, **type!**

Pycniis epiphyllis, gregariis, 75–100 μ diam. *Aeciis* hypophyllis, in greges usque 1.2 mm. diam. annulatum dispositis, breviter cylindraceis, 137–212 μ diam., margine albo leniter revoluto; *cellulis peridii* firme conjunctis, rhomboideis usque oblongis, 16–23 x 16–19 μ, pariete exteriore levi 3–4 μ crasso, interiore dense verrucoso 1.5–2 μ crasso; sporis globosis vel angulato-globosis, dense verruculosis, episporio ca. 1 μ crasso, hyalino, 18–20 x 16–18 μ.

Aecidium anningense sp. nov.

On *Sophora viciifolia*. **Yunnan**: Anning, April 24, 1938, *S. T. Chao*, *4334*, **type!**

Pycniis non visis. *Aeciis* amphigenis, etiam in petiolis et caulibus evolutis, matricem deformatibus, dense gregariis, breviter cylindraceis, 150–250 μ diam., margine lacerato, non revoluto; *cellulis peridii* firme conjunctis, 27–50 x 13–29 μ, pariete exteriore striato 4–6 μ crasso, interiore dense verrucoso 2–3 μ crasso; *sporis* variabilibus, subglobosis, ellipsoideis vel oblongis, 29–30 x 13–19 μ, dense verruculosis, hyalinis, episporio 1.5–2 μ crasso.

Aecidium Rhamni-japonici Diet.

On *Rhamnus* sp. **Yunnan**: Kunming, *4625*.

Aecidium pulcherrimum Rav.

On *Buchemia* sp. **Yunnan**: Kunming, *4311*.

Aecidium Eleagni Diet.

On *Eleagnus pungens*. **Szechuan**: Chengtu, *6822*; Omeishan, *6820*. On *E. angustifolia*. **Shensi**: Linkiang, *4327*. On *E.* sp. **Yunnan**: Kunming. *4305*.

Aecidium Circaeae Ces. et Mont.

On *Circaea imaicola*. **Yunnan**: Kunming, *4634*.

Aecidium Fraxini-Bungeanae Diet.

On *Fraxinus chinensis*. **Szechuan**: Omeishan, *6818*.

Aecidium Osmanthi Syd. et Butl.

On *Osmanthus fragrans*. **Chekiang**: Hangchow, *8440*.

Aecidium Klugkistiana Diet.

On *Ligustrum* sp. **Hunan**: Yolushan, Changsha, *4746*, *4747*.

Aecidium foetidum Diet.

On *Mazus stachydifolius*. **Szechuan**: Chengtu, *7548*.

Aecidium Paederiae Diet.

On *Paederia* sp. **Yunnan**: Wenshan, *4312*, *4313*.

Aecidium Cardui Syd.

On *Cardus crispus*. **Chekiang**: Hangchow, *8439*.

CAEOMA Link.

Caeoma Warburgianum P. Henn.

On *Rosa Banksiae*. **Yunnan**: Kunming, *4624*, *4635*, *5730*, *6356*, *8010*, *8011*, *8012*, *8026*; Hualing, *7684*; Lunan, *8998*. On *R. lucens*. **Yunnan**: Kunming, *8009*.

Pycnia epiphyllous, gregarious in groups (2–5 mm. in diam.), subepidermal, 175–230 μ in diameter. *Aecia* hypophyllous, petiolous or caulicolous, gregarious on orbicular spots (3–5 mm. in diam.) or scattered, roundish, sometimes confluent, naked, 1–2 mm. in diameter, "flame-scarlet" or "salmon-orange" (Ridgway); *aeciospores* various in shape: ovate, subglobose, globose or oblong, 19–29 x 16–20 μ (ovate, subglobose or globose), 29–37 x 13–15 μ (oblong), epispore 1.5–2 μ thick, hyaline, densely verrucolose, contents orange yellow when fresh.

This rust fungus is very close to *Caeoma Warburgianum* except that the oblong spores are slightly longer in size. It is characteristic in its unusual large and subepidermal pycnia and aeciospores of irregular shape. *Caeoma Warburgianum* was described by P. Hennings in 1899 on material collected by Warburg in 1887 at Ningpo, Chekiang, and it has not been collected again until now. The present writer has taken pains to search for the other stages of this rust at Kunming for the past few seasons, but without success.

UREDO Pers.

Uredo Cynodontis-dactylis sp. nov.

On *Cynodon dactylon*. **Yunnan**: Kunming, Aug. 15, 1942, *W. F. Chiu*, *7913*, **type!**; **Szechuan**: Chengtu, *6830*.

Urediis amphigenis, rotundatis vel ellipticis, epidermide diutius tectis, dein ea fissa cinctis, sparsis, 0.5–0.8 mm. longis, subpulverulentis, castaneo-brunneis; *uredosporis* subglobosis, ovoideis, rarius ellipsoideis, 29–42 x 23–33 μ, echinulatis, castaneo-brunneis vel cinnamomeo-brunneis, episporio 1.5–2 μ crasso; *poris germinativis* 2 aequatorialibus praeditis; *paraphysibus* peripheriicis, paucis, cylindraceis vel clavato-cylindraceis, flavidis, 37–57 x 13–18 μ, episporio 1.5–2 μ crasso.

This species differs from *Puccinia Cynodontis* in the larger and darker-colored uredospores and larger uredia; from *P. varians* in the larger and darker-colored uredospores, and from *P. Kühnii* in the darker-colored uredia and uredospores.

Uredo Arundinis-Donacis sp. nov.

On *Arundo Donax*. **Yunnan**: Kunming, June 2, 1938, *S. T. Chao, 7648*, **type!**

Urediis amphigenis, dense gregariis vel sparsis, rotundatis vel ellipticis, 0.5–1 mm. longis, epidermide diutius tectis, dein ea fissa cinctis, pulverulentis, castaneo-brunneis; *uredosporis* ovoideis, ellipsoideis vel oblongis, membrana ca. 2 μ crassa, ad apicem 3–4 μ crassa, cinnamomeo-brunneis vel subhyalinis, apice obscurioribus, echinulatis, 26–34 x 14–21 μ; *poris germinativis* 4 aequatorialibus praeditis; *paraphysibus* numerosis, capitatis, brunneolis vel subhyalinis.

Uredo Arthraxonis-ciliaris P. Henn.

On *Arthraxon hispidus*. **Yunnan**: Wenshan, *5037*.

Uredo Themedae Diet.

On *Themeda triandra*. **Szechuan**: Chengtu, *7557*.

Uredo Killingiae P. Henn.

On *Killingia brevifolia*. **Szechuan**: Chengtu, *7542*.

Uredo Verecunda Syd.

On *Achyranthes aspera*. **Yunnan**: Kunming, *4045*.

Uredo Deutziae Barcl.

On *Deutzia discolor*. **Yunnan**: Chichushan, Pinchuan, *4550*.

Uredo Panacis Syd.

On *Panax pseudo-ginseng*. **Yunnan**: Wenshan, *4527*; Sichour, *4528*, *6353*.

Uredia amphigenous, mainly epiphyllous, scattered or gregarious, roundish, 0.5–1 mm. in diameter, pulverulent, orange yellow; *uredospores* globose, subglobose or ellipsoid, echinulate, epispore 2–3 μ thick, hyaline, 23–29–(34) x 19–24 μ; *pores* obscure.

Uredo Colebrookiae Barcl.

On *Colebrookia oppositifolia*. **Yunnan**: Muhkiang, *6468*.

Uredia hypophyllous, scattered or usually densely gregarious, confluent, 0.35–0.6 mm. in diameter, pulverulent, yellowish; *uredospores* subglobose, epispore 1–1.5 μ thick, prominently and densely echinulate, subhyaline, 18–27 x 14–19 μ; *pores* obscure. The uredospores are slightly smaller than those described in the original diagnosis ("20–28 x 17–20").

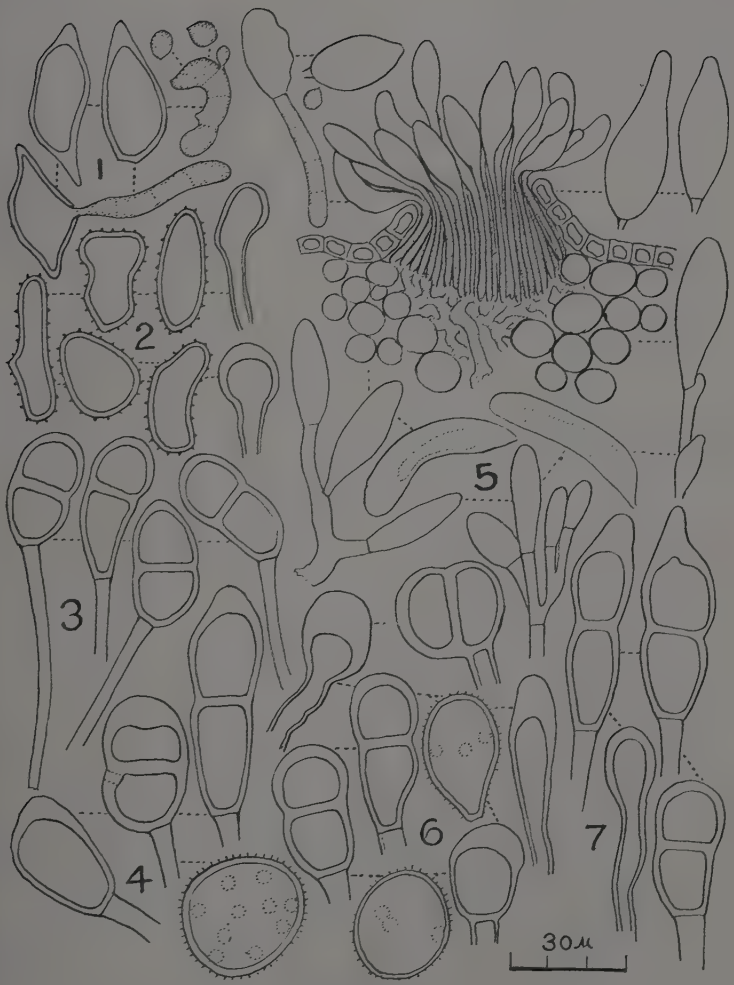
Uredo Zehneriae Thuem. (=*Uredo cantonensis* Yates)

On *Melothria* sp. **Yunnan**: Wenshan, *4398*.

EXPLANATION OF PLATE

Fig. 1–7.

1. *Cronartium Keteleeriae* Tai, teliospores.
2. *Melampsora Salicis-Cavaleriei* Tai, uredospores and paraphyses.
3. *Puccinia Festucae-ovinae* Tai, teliospores.
4. *Puccinia agrostidicola* Tai, uredospore, teliospores and mesospore.
5. *Gerwasia Rosae* Tai, section of a telium, teliospores, germinating teliospore, sporogenous hyphae and paraphyses.
6. *Puccinia Arundinellae-setosae* Tai, uredospores, teliospores, mesospore and paraphyses.
7. *Puccinia kwanhsienensis* Tai, teliospores and paraphysis.

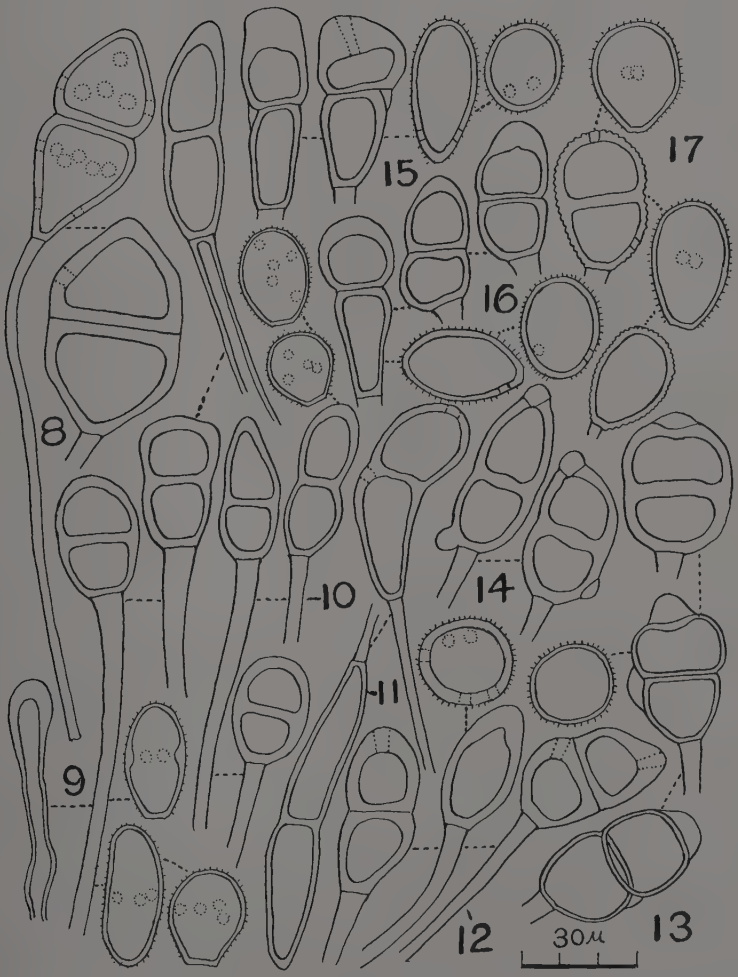


FIGURES 1–7

EXPLANATION OF PLATE

Fig. 8–17.

8. *Gymnosporangium Cunninghamianum* Barcl., teliospores, showing the position of the pores.
9. *Puccinia Kühnii* (Krug.) Butl., uredospores, teliospores and paraphysis.
10. *Puccinia Eragrostidis-ferrugineae* Tai, uredospores and teliospores.
11. *Puccinia Cinnamomi* Tai, teliospores.
12. *Puccinia taliensis* Tai, uredospore and teliospores.
13. *Puccinia leucophaea* Syd. & Butl., thick-walled and thin-walled teliospores.
14. *Puccinia clematidicola* Tai, teliospores.
15. *Puccinia polygonicola* Tai, uredospores and teliospores.
16. *Puccinia yunnanensis* Tai, uredospores and teliospores.
17. *Puccinia Glycyrhizae* Tai, uredospores, teliospore and mesospore.

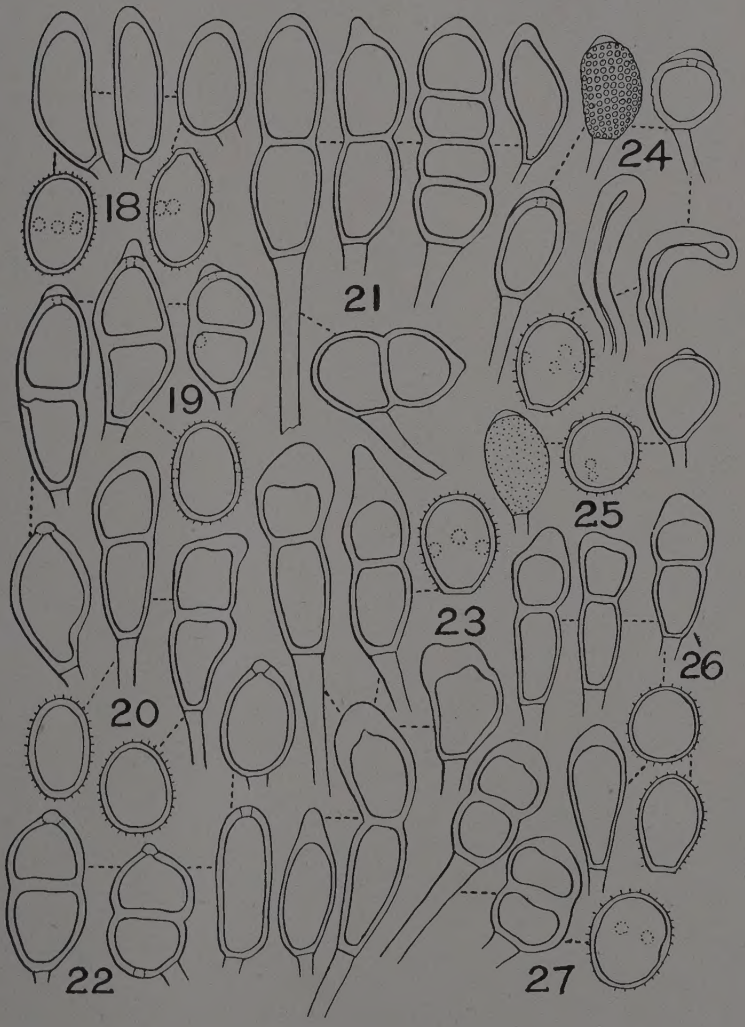


FIGURES 8–17

EXPLANATION OF PLATE

Fig. 18–27.

18. *Uromyces Sophorae-viciifoliae* Tai, uredospores and teliospores.
19. *Puccinia Impatientis-uliginosae* Tai, uredospore, teliospores and mesospore.
20. *Puccinia veratricola* Tai, uredospores and teliospores.
21. *Puccinia Saussureae-ussuriensis* Liou & Wang, teliospores and mesospore.
22. *Puccinia Wattiana* Barcl., teliospores and mesospores.
23. *Puccinia Yokokurae* P. Henn., uredospore, teliospores and mesospores.
24. *Uromyces rugulosus* Pat., uredospore, teliospores and paraphyses.
25. *Uromyces Kondoi* Miura, uredospore and teliospores.
26. *Puccinia Roscoeae* Barcl., uredospores, teliospores and mesospore.
27. *Puccinia Muehlenbeckiae* (Cooke) Syd., uredospore and teliospores.



FIGURES 18–27

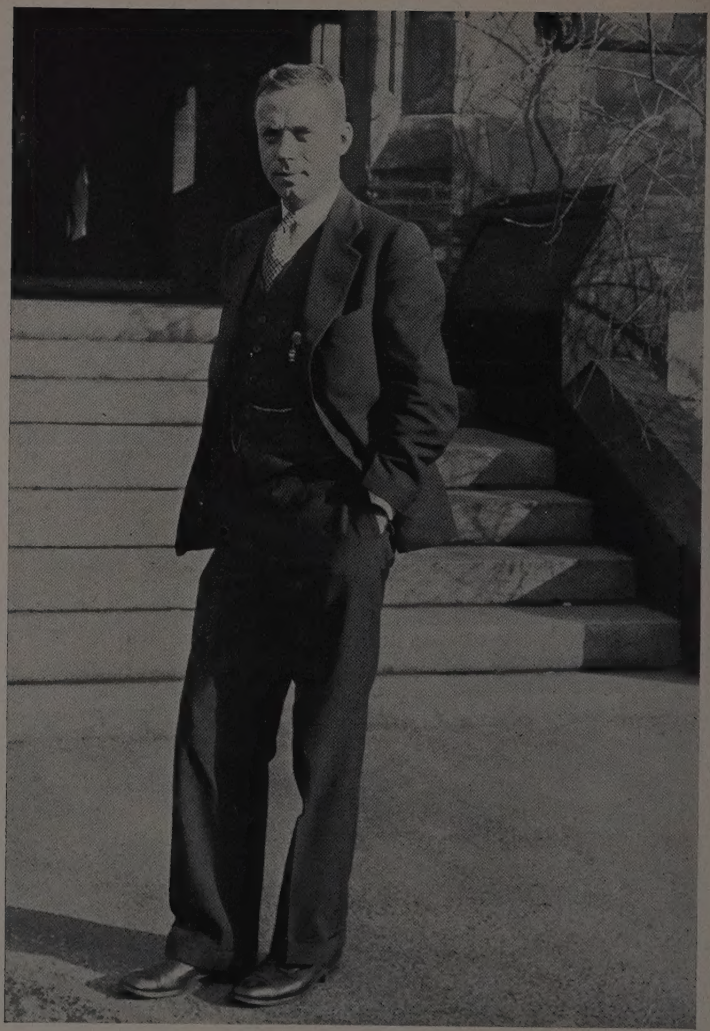


PLATE I

Dr. David Hunt Linder in front of the Farlow Library as photographed By Dr. Edwin E. Honey in 1939.